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ABSTRACT

Reported were extensive statistical data on the prevalence of abnormal eye conditions found on examination, heterophoria test results, and history of eye problems as well as extent of interrelationship of the eye examination and vision test findings among children aged 6 to 11 years in the United States, based on findings from the Health Examination Survey of 1963-1965. A total of 7,119 children were examined and were thought to be closely representative of the population from which they were drawn with respect to age, sex, race, region, and other demographic and socioeconomic variables. Selected major findings included: that nearly one-tenth of the children were found to have a disease condition or other abnormality in one or both eyes, that strabismus was the eye condition most frequently found, that two out of five children were found to have some marked degree of eye muscle imbalance, that significant deviations in the position of the binocular image at distance were likely to be ones of convergence or downward, that the prevalence of defective color vision was higher among children with defective than among those with normal visual acuity, and that the most frequent eye problems reported by parents for the children were those such as visual acuity defects and symptoms of burning or itching around the eye. (CB)

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DATA FROM THE NATIONAL HEALTH SURVEY
Series 11 - Number 115

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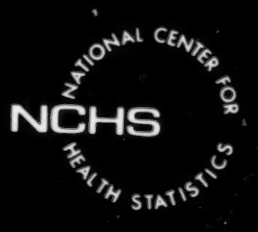

Eye Examination Findings Among Children

United States

U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service
Health Services and Mental Health Administration

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Series 11 reports present findings from the National Health Examination Survey, which obtains data through direct examination, tests, and measurements of samples of the U.S. population. Reports 1 through 38 relate to the adult program. Additional reports concerning this program will be forthcoming and will be numbered consecutively. The present report is one of a number of reports of findings from the children and youth programs, Cycles II and III of the Health Examination Survey. These reports, emanating from the same survey mechanism, are being published in Series 11 but are numbered consecutively beginning with 101. It is hoped this will guide users to the data in which they are interested.

Vital and Health Statistics-Series 11-No. 115

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Data from the
NATIONAL HEALTH SURVEY

Series 11
Number 115

Eye Examination Findings Among Children

United States

Eye examination findings, phoria test results, visual acuity, color deficiency, the history of eye trouble, and their relationship among children 6-11 years of age.

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Public Health Service

Health Services and Mental Health Administration
National Center for Health Statistics
Rockville, Md. June 1972

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COOPERATION OF THE BUREAU OF THE CENSUS

In accordance with specifications established by the National Health Survey, the Bureau of the Census, under a contractual agreement, participated in the design and selection of the sample, and carried out the first stage of the field interviewing and certain parts of the statistical processing.

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National Center for Health Statistics. "Eye Examination Findings Among Children, United States" VITAL AND HEALTH STATISTICS, Series 11, No. 115, DHEW Publication No. (HSM) 72-1057, 47 pp. Health Services and Mental Health Administration, DHEW, Rockville, Maryland, 20852.

This report from the National Center for Health Statistics presents data on eye examination and phoria (eye muscle imbalance) test findings. Included are their relationship to visual acuity and the history of eye trouble among children 6-11 years of age in the noninstitutionalized population of the United States, as measured in eye examinations, phoria tests, and medical histories in the Health Examination Survey of 1963-65. Data on the prevalence of color deficiency and its relationship to visual acuity as tested here are also included. For this survey a probability sample of 7,417 children was selected to represent the 24 million noninstitutionalized children in the United States. Of this sample the 7,119 or 96 percent examined were found to be closely representative of American children of this age with respect to age, sex, race, region, and other selected demographic and socioeconomic variables.

Nearly one-tenth of the children examined were found to have a disease condition or other abnormality in one or both eyes. Prevalence rates were slightly lower among younger than older children and among boys than girls. Strabismus, manifest or latent, was the condition most frequently found. It affected one child in 14, but only one-third of these had a manifest condition or squint. Prevalence of each of the three infectious or allergic conditions identified in the examination--blepharitis, conjunctivitis, and stye--was less than 1 percent.

Vision tests showed two children out of five to have a marked degree of eye muscle imbalance (heterophoria). At distance, deviations were most likely to be ones of convergence (esophoria) or downward (hypophoria) while at near relatively more of the children had divergent deviation (exophoria). Children with defective visual acuity (less than 20/40 or 14/35) were more likely than those with normal vision to have some form of strabismus, heterophoria, or defective color vision. The most frequent past and present eye problems reported by parents were visual acuity defects (10 percent of the children wore glasses or contact lenses), symptoms of burning or itching around the eyes, infections or related conditions such as styes, and frequent rubbing or blinking of eyes when reading.

Included are descriptions of the eye examination, vision tests, and medical history as well as the survey design and reliability of estimates.

Copies of "Eye Examination Findings Among Children, United States" VITAL AND HEALTH STATISTICS, Series 11, No. 115, DHEW Publication No. (HSM) 72-1057, 47 pp., may be purchased for 50 cents from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

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EYE EXAMINATION FINDINGS AMONG CHILDREN

Jean Roberts, *Division of Health Examination Statistics*

INTRODUCTION

Contained in this report are the eye examination and phoria test findings with their relation to visual acuity and history of eye trouble among children aged 6-11 years in the United States as estimated from the Health Examination Survey programs of 1963-65.

The Health Examination Survey, from which these data derive, is one of the major programs of the National Center for Health Statistics, authorized under the National Health Survey Act of 1956 by the 84th Congress as a continuing Public Health Service activity to determine the health status of the population.

Three different programs are used in carrying out the National Health Survey.[1] The Health Interview Survey, collecting health information from samples of people by household interview, is focused primarily on the impact of illness and disability within various population groups. The Health Resources program obtains health data as well as health resource and utilization information through surveys of hospitals, nursing homes, and other resident institutions and the entire range of personnel in the health occupations. The Health Examination Survey, from which data in this report were obtained, collects health data by direct physical examination, tests, and measurements performed on samples of the population. The latter program provides the best way of obtaining actual diagnostic data on the prevalence of certain medically defined illnesses. It is the only way to secure information on unrecognized and undiagnosed conditions and on a variety of physical, physiological, and psychological measures within the population. It also collects demographic and socioeconomic data on the sample population under study with which the examination findings for those persons may be interrelated.

The Health Examination Survey is organized as a series of separate programs, or cycles, each of which is limited to some specific segment of the United States population and to specific aspects of health. From data collected during the first cycle, the prevalence of certain chronic diseases and the distribution of various physical and physiological measures were determined among a defined adult population, as previously described.[2,3]

For the second cycle, or program, on which this report is based, a probability sample of the noninstitutionalized children 6-11 years of age in the United States was selected and examined. The examination consisted primarily of an assessment of health factors related to growth and development. It included an examination by a pediatrician and by a dentist, tests administered by a psychologist, and a variety of tests and measurements by a technician. The survey plan, sample design, examination content, and operation of the survey have been described in a previous report.[4]

Field collection operations for this cycle, started in July 1963, were completed in December 1965. Of the 7,417 selected in the sample, 7,119 children, or 96 percent, were examined. This national sample is closely representative of the roughly 24 million noninstitutionalized children aged 6-11 years in the United States with respect to age, sex, race, region, size of place of residence, and rate of

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population change in size of place of residence from 1950 to 1960.

Each child, during his single visit, was given a standardized examination by the examining team in the mobile units specially designed for use in the survey. Prior to this examination, demographic and socioeconomic data on household members as well as medical history, behavioral, and related data on the child to be examined were obtained from his parents. Ancillary data were requested from the school attended by the child, including his grade placement, teacher's ratings of his behavior and adjustment, and health problems known to his teacher. A birth certificate was obtained for each child for verification of his age and information related to his condition at birth.

Statistical notes on the survey design, reliability of the data, and sampling and measurement error are shown in appendix I.

DATA SOURCES

Eye Examination

Each child was given a standardized eye examination designed for this survey, which included careful inspection primarily for evidence of styes, conjunctivitis, blepharitis, nystagmus, ptosis, and strabismus. (See appendix II.)

In testing for strabismus the pediatrician used one or more of the following methods: observation, moving light test, screen or cover test, and Hirschberg test. Where strabismus was detected, the location, type, and confirming tests used were recorded.

For the *moving light test,* used in detecting manifest strabismus, the child was asked to follow with his eyes the movement of a fixation light. The examiner moved it up, down, straight out to the right, down and right, up and right, and similarly on the left to note the position of the eye in each of eight cardinal positions. Presence of strabismus in any of these positions was noted and recorded.

In the *Hirschberg* or *corneal light reflex test* for manifest strabismus, the examinee was asked to look at a fixation light held at eye level about 14 inches from the eyes. Observing from directly behind the light, the examiner noted the location of the corneal reflex produced by the examining light. The direction of deviation, if any, of the light image from the normal position, i.e., slightly to the nasal side of the center of the pupil, was recorded.

During the *screen or cover test* for strabismus the child was asked to continue looking at a designated fixation spot on the wall while the examiner passed a card slowly back and forth alternately before the child's right and left eye. Movement of the covered eye to regain the position of binocular fixation on the spot following removal of the screen from in front of it was considered strabismus and the direction of the deviation was recorded.

Vision Tests

The vision battery included tests to determine the degree of horizontal phoria at distance and near and of vertical phoria at distance, monocular and binocular tests to measure the level of central visual acuity at distance and near, and tests to detect and classify color vision deficiencies. (See appendix II.)

Phoria and visual acuity testing was done with selected targets developed for the Armed Forces using the Bausch and Lombe Master Ortho-Rater instruments, as described in the report *Visual Acuity of Children, United States.*[5] Only binocular visual acuity findings are utilized in this report.

The degree of eye muscle imbalance or misalignment of the visual axes, which under conditions of normal binocular viewing is corrected by the fusional capacity of the eyes in latent strabismus but not in manifest strabismus or apparent concomitant squint, was measured using binocular tests on three of the Ortho-Rater plates. For each plate, the eyes are disassociated by having each see a separate nonfusable image.

On the two lateral phoria plates, the left eye views a prominent vertical arrow pointed downward at the middle of three evenly spaced dots, while the right eye views a longer horizontal row of similarly spaced dots of size identical to those seen by the left eye, the

spacing being at distances of one prism diopter (Δ). The dots seen by the right eye are numbered consecutively from left to right, with only the odd numbers showing for ease in reading. The range for the distance plate is from 0 through 22 and for the near plate from 0 through 34. Under normal binocular viewing the point of binocular fusion of the arrow image and the dots would be at dot number 11 on the distance plate and dot number 13 on the near plate. If the fusion point for the two images is to the left of the normal position, the two eyes are converging (esophoria), while if to the right, the eyes are diverging (exophoria), the position of the fusion point indicating the degree of imbalance laterally.

The single plate measuring vertical phoria at distance follows a similar principle. Here the left eye sees a series of tiny dots in the horizontal plane while the right eye sees a row of numbered stairsteps, the steps numbered in sequence from the lowest (1) to the highest (9). The rise of the steps here is in half-diopter units, with the normal fusion point for the two images being at step 5. Deviations in alignment upward (above five) are termed hyperphoria; downward (below five) are hypophoria.

Thus horizontal phoria at distance was measured in prism diopters (Δ) of convergence (deviation to the left of the normal fusion point) from 1 to 11 diopters or more of esophoria and to the right of the normal fusion point from 1 to 11 diopters or more of divergence, or exophoria. Lateral phoria at near was measured in prism diopters of deviation to the left (convergence) from 1 to 21 or more diopters of esophoria and to the right from 1 to 13 diopters or more of exophoria (divergence). Vertical phoria at distance was measured in half-diopter units from 0.5 to 2.5 diopters above (hyperphoria) and 0.5 to 2.5 diopters below the normal position in the vertical plane (hypophoria).

For detecting color vision deficiencies prior to classifying them, selected plates of the Ishihara test were used in the preliminary screening. Those children identified as probably having a color vision deficiency on the Ishihara test were then given the Hardy-Rand-Rittler test to confirm the findings and determine the type and severity of the deficiency. Only those identified as possibly having defective color vision on the Ishihara test are included in this report. Testing for color vision deficiencies was done with glasses if the child wore them.

Medical History

At the time of the initial visit to the sample household, the Census interviewer left a self-administered medical history with the parents for each eligible child. These were picked up about a week later by the Health Examination Survey Representative, who reviewed them and assisted the parent in completing any incomplete or inconsistent entries. There were 14 questions on the form directly related to vision difficulties or other eye conditions (appendix II).

The staff pediatrician reviewed the medical history in advance of the examination and administered further special examinations in those instances where either the medical history or his initial examination made him suspect the presence of an eye defect.

FINDINGS

From the Eye Examination

Nearly one-tenth (91.8 per 1,000 children), or 2.2 million of the 24 million children aged 6-11 years in the noninstitutionalized population of the United States, were found to have an eye muscle imbalance, a disease condition, or other abnormality in one or both eyes, as estimated from these Health Examination Survey findings (tables 1 and 2).

The prevalence of eye conditions was slightly, but not significantly, lower among younger children of 6 and 7 years than those 8 years and over, but no consistent age-related trend was evident. Boys were somewhat less likely than girls to have such conditions, the prevalence among the former being lower up to age 11 years.

Strabismus was the condition found most frequently (figure 1). Nearly one child in 14 (67.2 per 1,000 children), or an estimated 1.6 million, had sufficient eye muscle imbalance to be rated as having strabismus. The latent form of heterophoria, which is corrected by the fusional

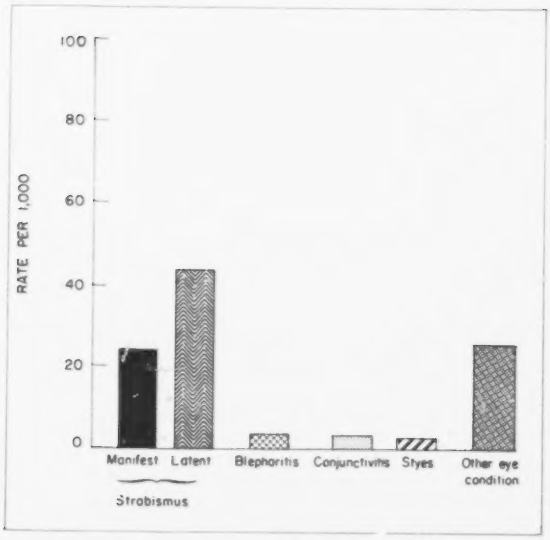

Figure 1. Prevalence of principal infectious and functional eye conditions found on examination among children 6-11 years of age: United States, 1963-65.

capacity of the eyes in binocular vision,[6] was nearly twice as prevalent as the manifest condition, in which the misalignment of the visual axes persists even when binocular viewing is attempted (43.4 per 1,000 compared with 23.8 per 1,000).

Prevalence rates for the three infectious or allergic conditions of the eyelids identified in this examination were each less then 1 percent. Blepharitis (a chronic inflammation of the lids) and conjunctivitis (inflammation of lining of the lids or the eyeball) were each observed among about 4 children per 1,000, while styes (inflammation of the Zeis glands in the lid) were present in less than 3 per 1,000.

Other eye conditions not specifically identified as to type in the examination were found among nearly 27 children per 1,000. These conditions were principally scars from an eye operation for strabismus or an injury.

Manifest strabismus or squint was found as frequently among boys as girls. The prevalence rates showed no consistent age-related trend among either group, the rates being lowest among 6-year-old girls (11.7 per 1,000) and 7-year-old boys (15.6 per 1,000) and highest among 7-year-old girls (31.3 per 1,000) and 8-year-old boys (32.5 per 1,000), as shown in figure 2.

Latent strabismus was found more frequently among girls than boys throughout the age range in the study, the difference in rates being large enough to be statistically significant at all but 9 and 11 years (figure 3).

Conjunctivitis was found significantly more frequently among boys than girls (5.8 compared with 2.8 per 1,000), while blepharitis was found slightly less frequently among boys than girls (3.5 and 5.3 per 1,000, a difference which is not statistically significant). Styes were present about as often in boys as girls (2.9 and 3.0 per 1,000). No consistent age-related trend was evident for these conditions. The sex differential indicated above was found throughout the age range for conjunctivitis except at age 10 and for blepharitis except at ages 6 and 11 years.

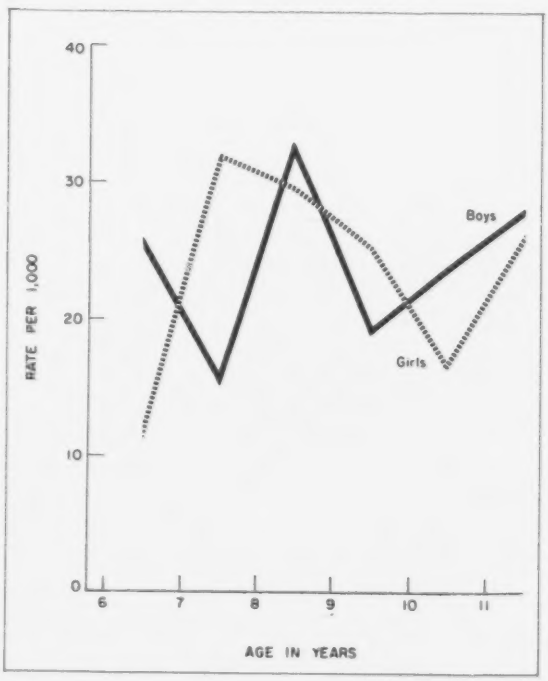

Figure 2. Prevalence of manifest strabismus among boys and girls, by age: United States, 1963-65.

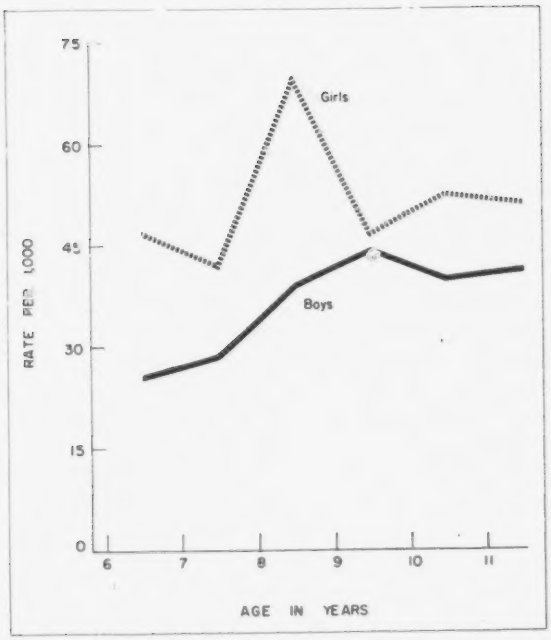

Figure 3. Prevalence of latent strabismus among boys and girls, by age: United States, 1963-65.

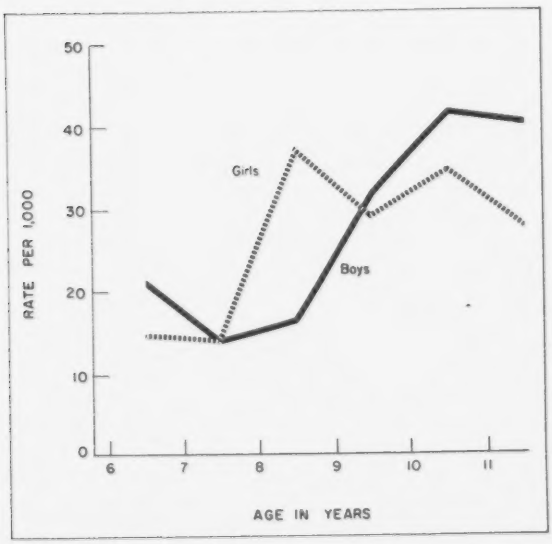

Figure 4. Prevalence of other eye conditions among boys and girls, by age: United States, 1963-65.

Other eye conditions were found slightly more frequently among boys than girls at ages 6, 7, and 9-11 years and somewhat less frequently among younger than older children (figure 4).

A child found to have one of the infectious or allergic conditions identified here—blepharitis, conjunctivitis, or stye—was more likely to have a single than multiple infection or allergic manifestation. Similarly, those with strabismus were more likely to have the problem of eye muscle imbalance without further complications (table 3).

For the detection and identification of strabismus in the examination, the screen or cover test and the moving light were used more frequently than the Hirschberg (corneal light reflex test) or observation. The condition was identified by a combination of two or more tests for about 47 percent of these children, by screen only for more than one in three, by moving light only for 1 percent, and by Hirschberg or observation only for one in seven (table 4).

Through these tests, in addition to identifying the type of strabismus present, the examiner determined roughly the degree and direction of involvement for each eye. In manifest strabismus one eye was substantially more likely to be affected than both (three out of four children), while those with the latent form were much more likely to have both eyes with deviant gaze than just one (nearly three out of four children). (Figure 5.) For either type, when only one eye was involved it was about as likely to be the right as the left eye (table 5). This pattern was similar for boys and girls and no consistent age-related trend was evident.

In both forms of strabismus the direction of deviant gaze in the eye affected was most likely to be directly convergent or divergent in the horizontal plane (tables 6-9). Children with manifest strabismus were more likely to have the deviation be horizontally convergent or divergent (47 and 25 percent, respectively) and less frequently in some other direction off the horizontal plane (6 percent up or down, 23 percent a combination). Similarly, for those with a latent condition the deviation was less likely to be in a direction off the horizontal plane (28 percent) than directly divergent (42 percent) or convergent (27 percent). When the

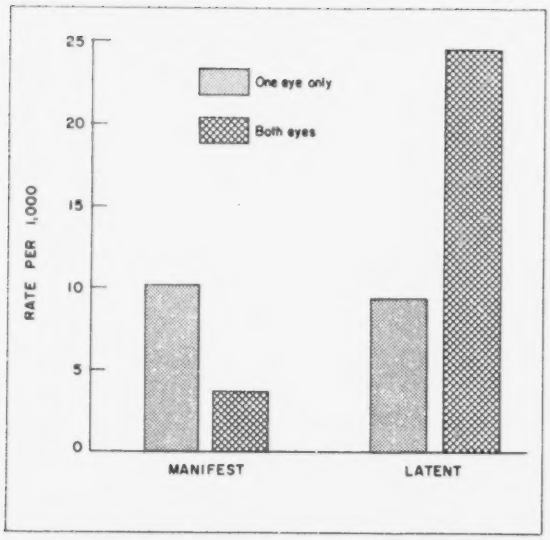

Figure 5. Prevalence of strabismus among children 6-11 years of age, by type and extent of eye involvement: United States, 1963-65.

left eye was affected with manifest strabismus, the deviation was substantially more likely to be inward (54 percent) than outward (17 percent), while the reverse was found for those with latent involvement (21 and 47 percent, respectively).

The usual direction of deviation when both eyes were affected was slightly more likely to be convergent in manifest and divergent in latent strabismus.

From the Phoria Tests

The degree of eye muscle imbalance or misalignment (heterophoria) in the lateral and vertical planes at distance (26 feet simulated) and in the lateral plane at near (13 inches) were measured for each child on the phoria tests in the Ortho-Rater under conditions of binocular viewing but with the stimulus to fusion low. These tests measured in prism diopter units the distance of the point of fusion, or binocular fixation, of the different images seen by each eye from the normal fusion point when there was no imbalance.[6] The distribution of the deviations among children is shown in table 10 and figures 6-8.

In this report deviations of the binocular fixation point in the horizontal plane at distance of 5 prism diopters (Δ) or more of convergence (inward from normal) are considered significant esophoria, and 5 prism diopters or more of divergence (outward from normal), significant exophoria. At near, deviations of 6 prism diopters or more of convergence are considered significant esophoria, and 10 prism diopters or more of divergence, significant exophoria. Deviations in the vertical plane of 1½ prism diopters or more above or below the normal fusion point were considered significant hyperphoria and hypophoria, respectively. These critical levels are generally consistent with those found in a previous study to be the ones most frequently recommended by practicing ophthalmologists and optometrists as the basis for referring children for further visual attention and care.[7,8]

Survey findings showed that about one-third of the children had some marked degree of eye muscle imbalance as rated here (32.4 percent).

Among children 6-11 years of age in the United States, 85 percent, or 20.3 million children, had essentially normal lateral eye muscle balance at distance; that is, the deviation of their binocular fusion point for the two images seen by the eyes deviated less than 5 prism diopters to the right (divergence) or left (convergence) of the normal position. About one-fifth showed no deviation at all (less than 1 prism diopter). For those with some imbalance in this plane the deviation was more likely to be convergence than divergence. Thirteen percent, or 3.1 million, were rated as significantly esophoric, while only one percent were significantly exophoric. No age or sex differential was evident (tables 11 and 12 and figure 9).

Nearly as many children had essentially normal eye muscle balance or coordination in the vertical as in the horizontal plane. For 84 percent, or 20.2 million children, the image fusion point was less then 1.5 prism diopters above or below the normal position. Significant eye muscle imbalance in the vertical plane was more likely to be right hyperphoria (upward—10 percent) than right hypophoria (downward—5 percent). About half of the children showed no

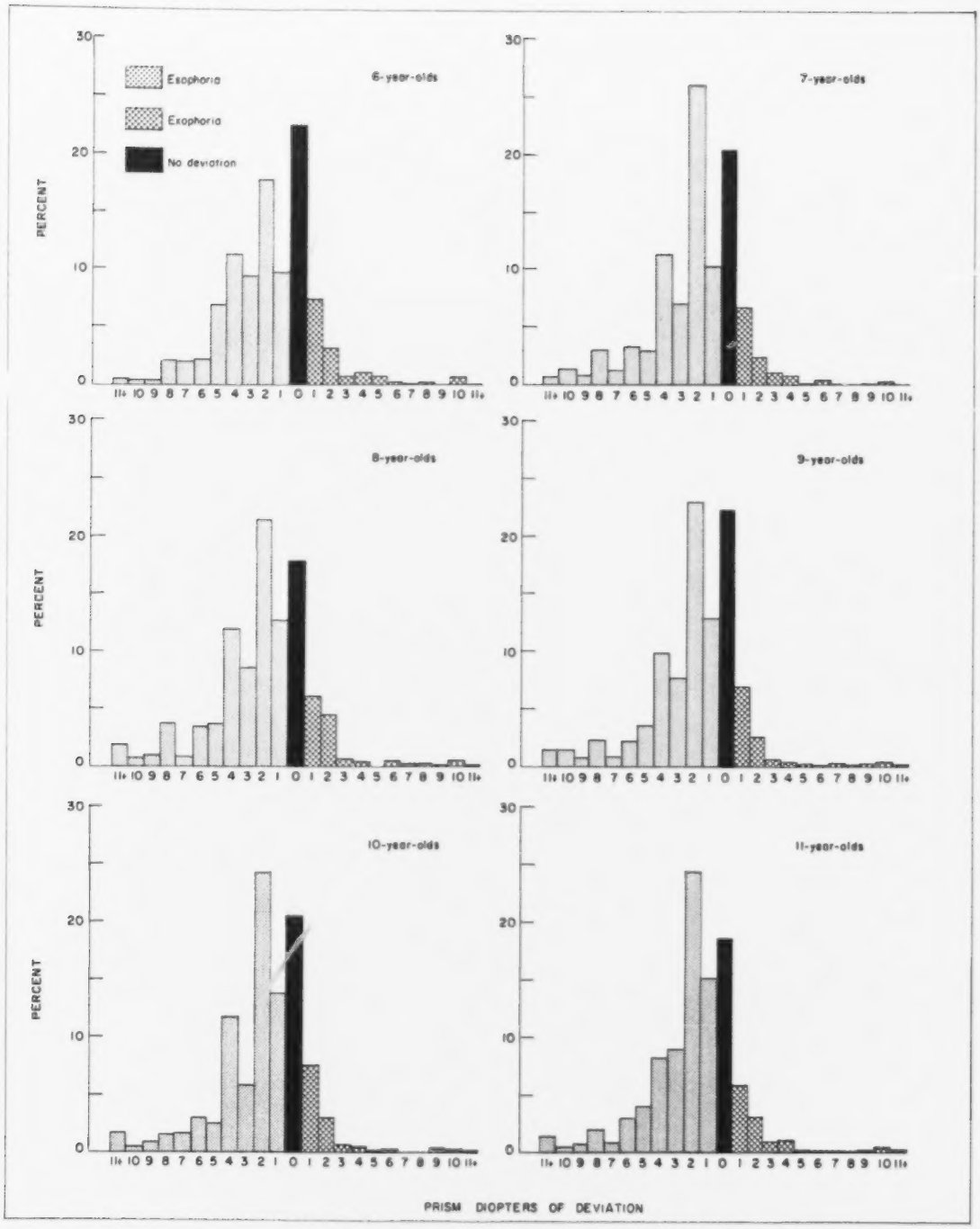

Figure 6. Percent of children at each year of age by prism diopters of lateral phoria at distance: United States, 1963-65.

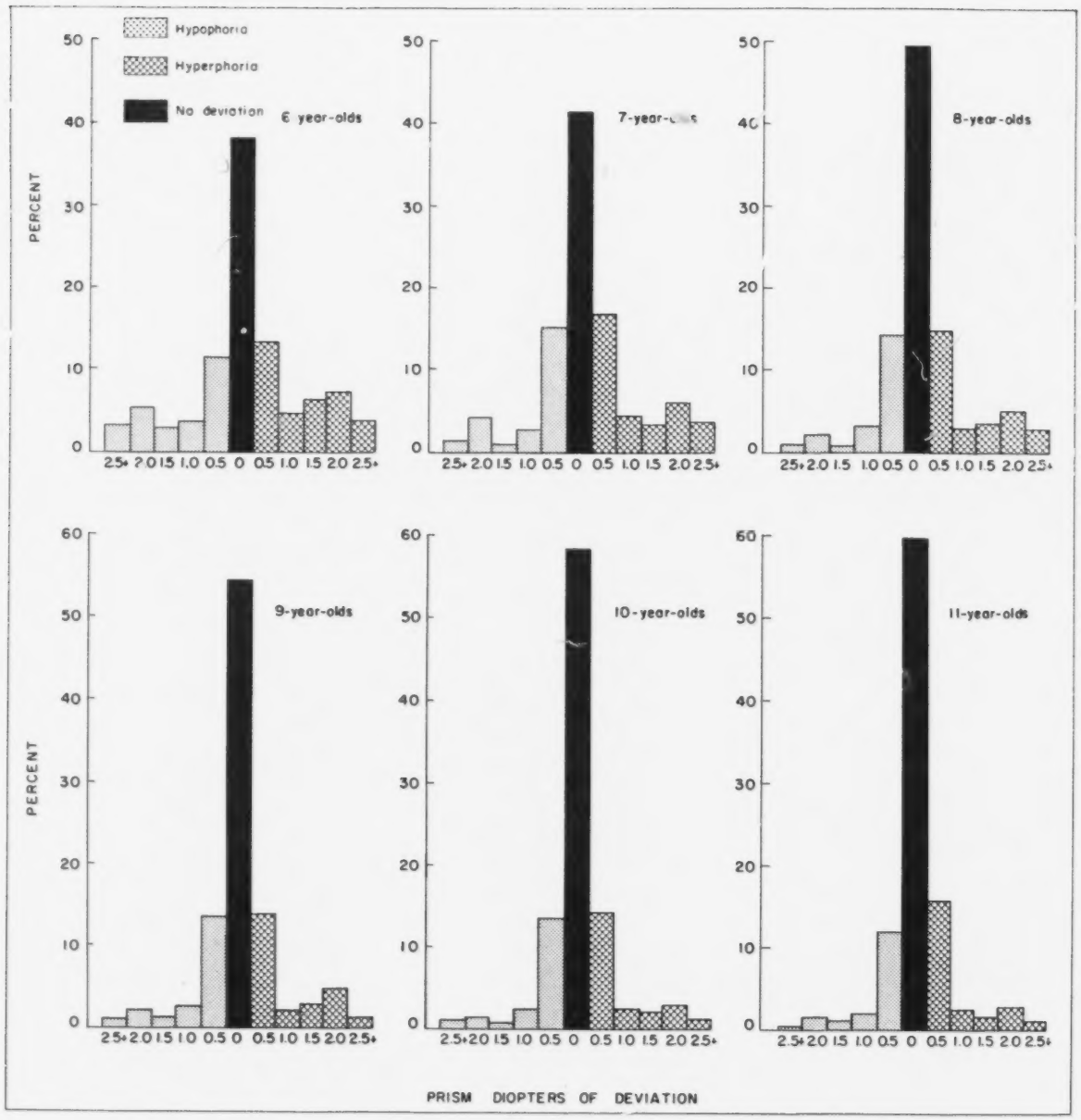

Figure 7. Percent of children at each year of age by prism diopters of vertical phoria at distance: United States, 1963-65.

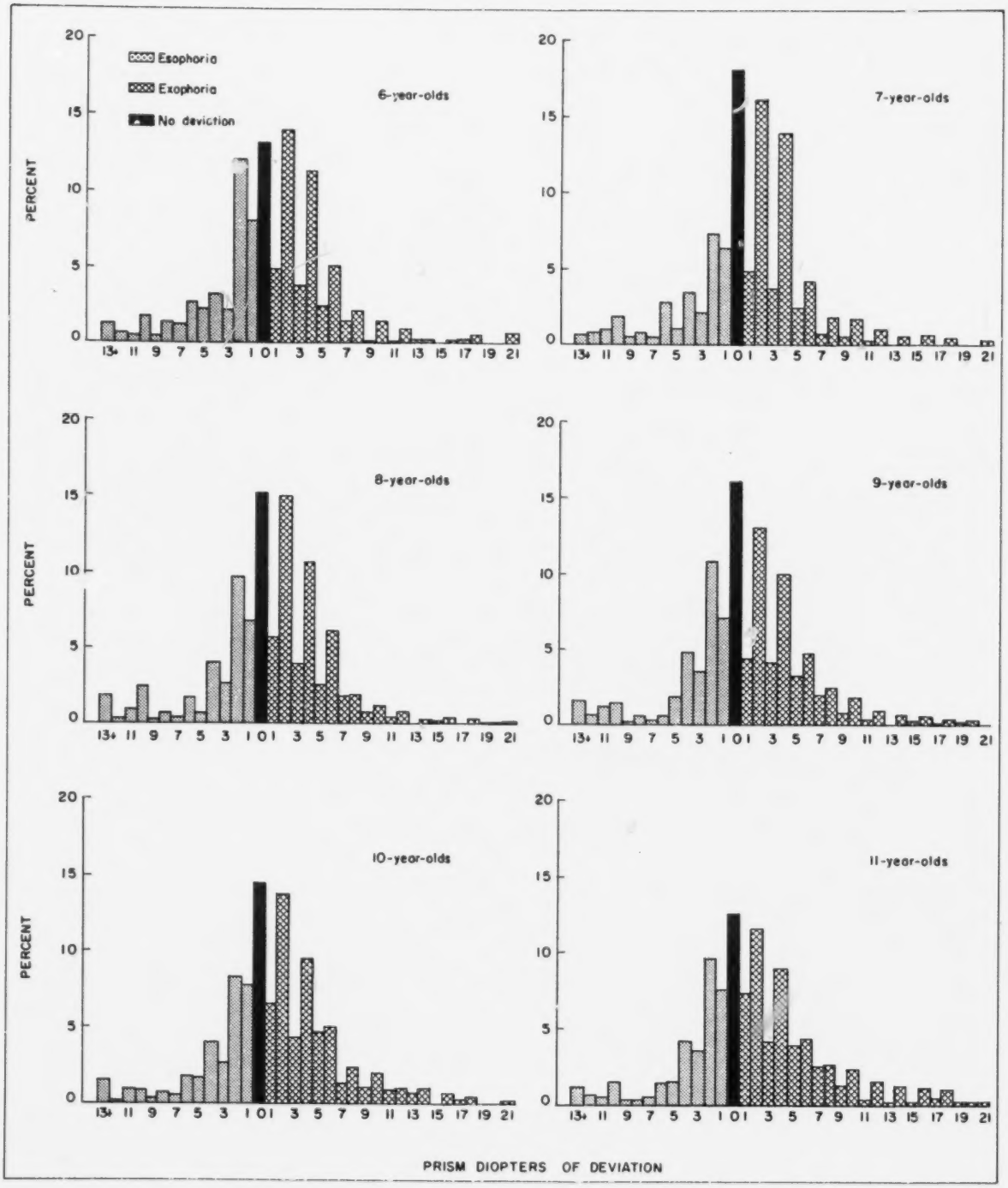

Figure 8. Percent of children at each year of age by prism diopters of lateral phoria at near: United States, 1963-65.

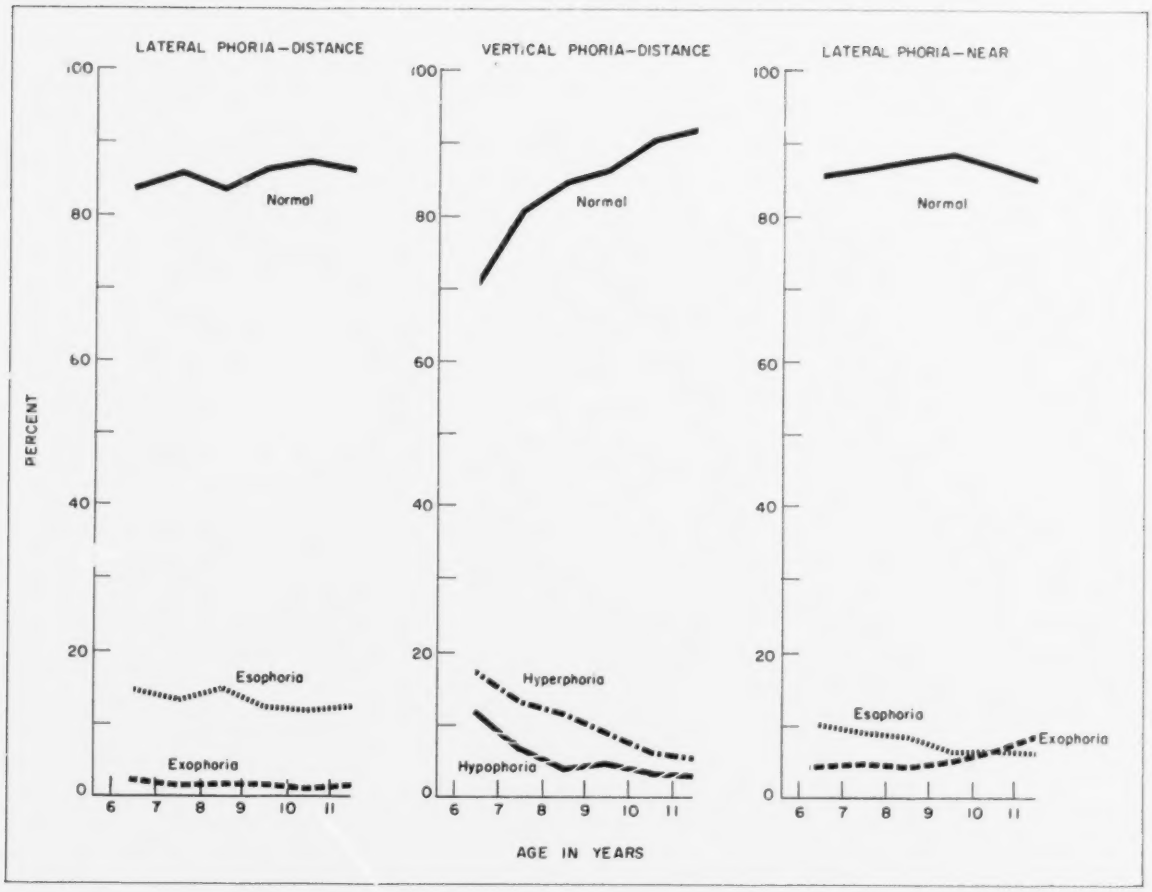

Figure 9. Percent of normal children 6-11 years of age and those with significant heterophoria on test at distance and near by age: United States, 1963-65.

deviation at all. The proportion considered essentially normal (less than 1.5 prism diopters of deviation) increased significantly with age from 71 percent among 6-year-olds to 92 percent among the 11-year-olds. Both the proportions with marked downward or upward deviations showed a corresponding significant decrease with age from 11 percent among 6-year-olds to 3 percent among 11-year-olds with a downward hyperphoria and from 18 percent at age 6 years to 6 percent at age 11 for those with a marked deviation upward.

Significant lateral phoria at near was found just slightly more frequently among these children than the corresponding condition at distance. Nearly 87 percent, or 20.8 million children, were essentially normal (with deviation less than 1.5 prism diopters). About 15 percent showed no deviation at all. Of those with some imbalance, the deviation was more likely to be one of divergence (55 percent) than convergence (30 percent). However, since the critical level for significant divergence was set higher (10^{Δ} or more) than for convergence (6^{Δ} or more), the proportion with significant near esophoria (8 percent) slightly exceeded that for significant near exophoria (6 percent). No significant age-related pattern is evident, although the

prevalence of marked near exophoria generally increased with age, while that for marked near esophoria decreased.

Children are more likely to have only one type of imbalance in their binocular vision but, if more than one, to have both a distance and near lateral imbalance in the same direction. The extent of joint occurrence of these types of eye muscle imbalance, as measured by linear correlation methods, is significant between lateral phoria at near and distance ($r = +.40 \pm .018$) but is, as expected, negligible to nonexistent between distance lateral and vertical phoria ($r = +.05 \pm .019$) as well as between distance vertical phoria and near lateral phoria ($r = +.06 \pm .024$).

Eye Examination—Phoria Tests

Only about one-eighth (13 percent) of those children rated as having significant heterophoria or eye muscle imbalance on the Ortho-Rater vision tests were considered by the examining pediatrician to have either manifest or latent strabismus. As previously described, the examination given by the pediatrician would be expected to detect only the more deviant conditions.

The prevalance and direction of the significant binocular heterophoria found on the vision tests among normal children and those with strabismus are shown in figure 10 and tables 13-15. As expected, significant heterophoria (from Ortho-Rater tests) was substantially more prevalent (relatively) among those with strabismus than the normal group—63 percent compared with 30 percent, respectively. Children with manifest strabismus more often than those with a latent condition were found on these tests to have marked heterophoria (88 percent compared with 49 percent), the difference being statistically significant here also. Those with a manifest condition were more likely than the latent group to have this be a substantial esophoria at distance and near or a significant hypophoria at distance. Marked exophoria (divergence) and deviation upward (hyperphoria) were found about as frequently among those with manifest as with latent strabismus.

Vision Tests—Eye Conditions

Children with defective visual acuity were substantially more likely than the normal group to have strabismus, either manifest or latent. Among the 75 percent testing 20/20 or better without glasses at distance, only 5.6 percent were found to have strabismus, while among the 7 percent with binocular acuity of less than 20/40, relatively twice as many (13 percent) had such a condition (table 16). The differential is even more marked at near, where the prevalence of strabismus was 5.5 percent among the 73 percent testing 14/14 or better without glasses compared to a prevalence nearly three times as great (16 percent) among those (2 percent) with defective near acuity of less than 14/35 (table 17). A negative relationship is evident here, with the prevalence of strabismus generally increasing as acuity decreases.

While the prevalence of either manifest or latent conditions is significantly greater among children with defective than normal visual acuity, the differential is larger for those with manifest than latent strabismus and somewhat greater for near than distance acuity (figure 11). Hence children with manifest strabismus are more likely than those with a latent form to have defective visual acuity.

The prevalence of strabismus in relation to visual acuity shows no consistent age-related pattern. Manifest strabismus was found about as frequently among boys as girls across the acuity range, while the prevalence of latent strabismus was slightly less for boys than girls, consistent with the pattern found for these conditions without regard to visual acuity.

The relationship of the heterophoria test results to visual acuity is generally similar to that found with strabismus. Children with normal visual acuity were less likely than those with defective acuity to have a significant esophoria or exophoria. The relationship between these findings at near was even stronger than at distance (tables 18 and 19). Little relationship was found between acuity and the vertical phoria test results.

The relationship of defective color vision to visual acuity may be seen in table 20. Children with defective visual acuity were more likely

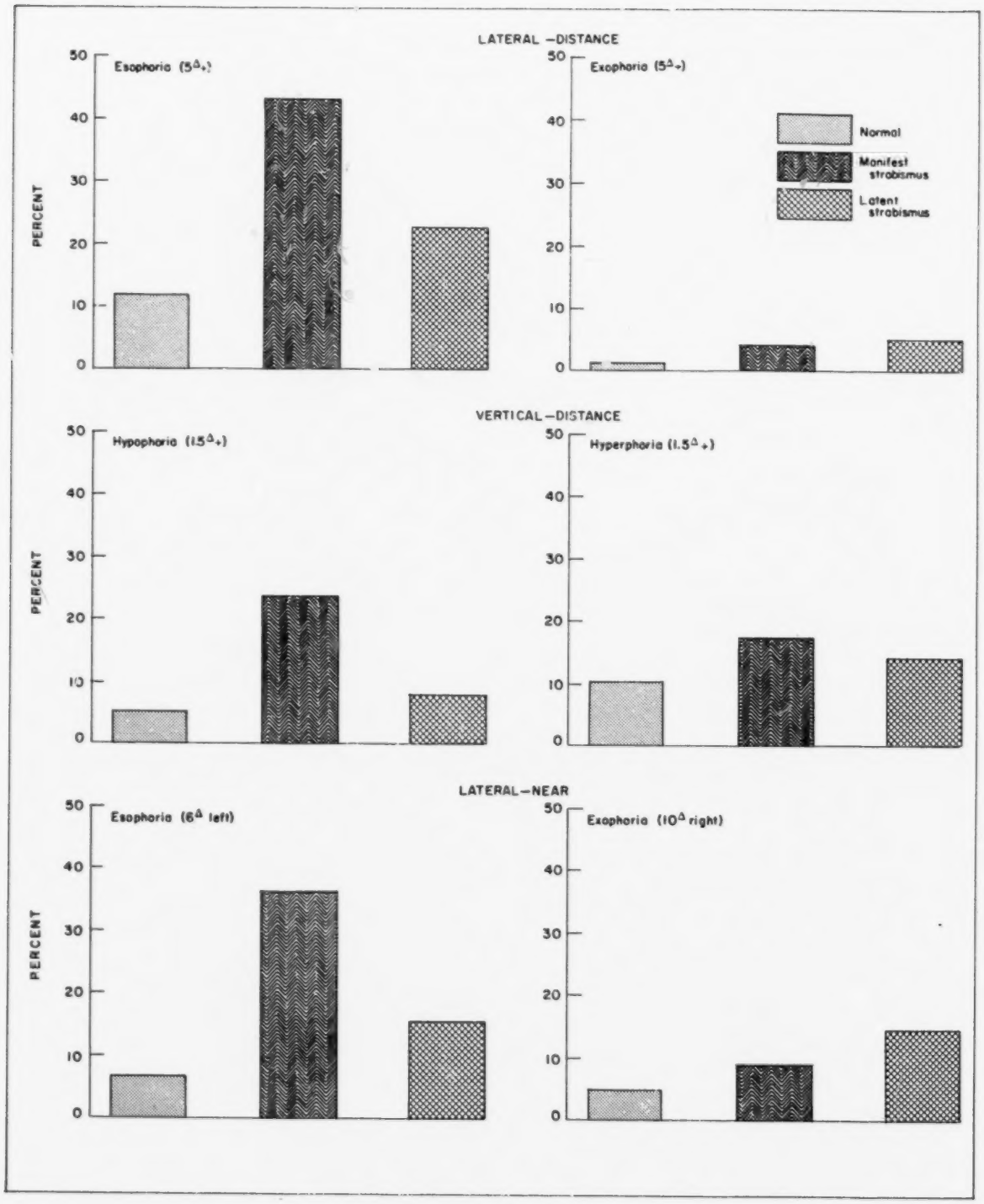

Figure 10. Percent of normal children 6-11 years of age and those with manifest or latent strabismus found to have significant heterophoria on test at distance or near: United States, 1963-65.

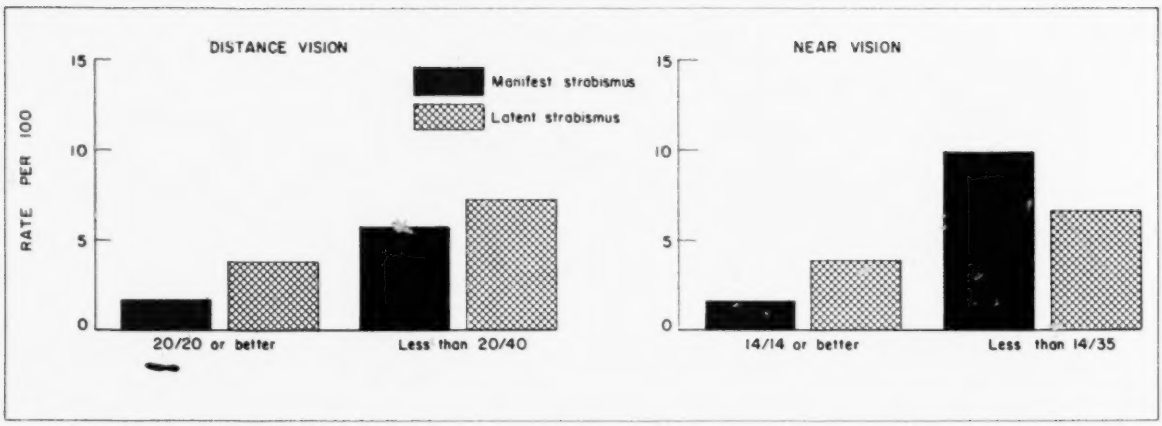

Figure 11. Prevalence of strabismus among children 6-11 years of age with normal and defective visual acuity: United States, 1963-65.

than those with normal acuity to also have defective color vision as determined by the abbreviated form of the Ishihara test used for screening in the study. For boys the prevalence of color vision deficiencies was 7 percent among those with 20/20 or better vision compared with 15 percent among those with acuities of less than 20/40. Among girls a similar contrast was found but the proportion with color deficiencies (1.4 percent) was so small that the differences between the groups with normal and defective acuity were not statistically significant. These findings are similar to those among adults in the United States from the 1960-62 Health Examination Survey, where those who reported having a color vision deficiency tended to have poorer visual acuity than those who did not.[9]

From the Medical History

The eye problems most frequently reported by their parents for these children were visual acuity defects (10.3 percent wear glasses or contact lenses), symptoms of burning or itching around the eyes (9.2 percent), specific infectious or related conditions such as styes or other foreign matter in the eye (8.8 percent), and frequent rubbing or blinking of eyes when reading (7.5 percent). Somewhat less frequently reported were abnormal sensitivity to light (5.8 percent), further symptoms of eye infections, visual acuity problems, and eye muscle imbalance (table 21).

Eye problems, including wearing glasses, trouble with reading, eyes often bloodshot, burning or itching eyes, seeing double, and a tendency to cover one eye when watching television or reading show a fairly consistent increase with age and, except for the bloodshot condition, are found somewhat more frequently among girls than boys. For the other conditions and symptoms no age-related trends are evident.

For about half of the children whose parents indicated they had had an operation on their eyes, a history of crossed eyes was also given (table 22). One child in eight who wore glasses was found to have a history of crossed eyes, while for about one child in twelve whose parents said they sometimes do cover an eye while reading or watching television was a history of crossed eyes given.

Medical History—Eye Conditions

The relationship of present eye conditions among children as found on examination to the history of these or possibly related conditions is shown in table 23.

Children found on examination to have styes were more likely (2.1 percent) than not (0.1 percent) to have had a history of such a condition, though the difference in prevalence

rates was not large enough to be statistically significant.

Those found to have conjunctivitis were more likely than not to have a history of styes, swollen lids, watery or bloodshot eyes, burning or itching eyes, or be light-sensitive, though again the differences in the prevalence rates were not large enough to be statistically significant.

Children with blepharitis were slightly, but not significantly, more likely than not to have had a history of swollen lids, rubbing of eyes, watery eyes, or other eye conditions.

Those with strabismus were significantly more likely than not to wear glasses or frequently cover one eye when reading or watching television.

Children with other eye conditions found on examination more frequently than not had a history of an eye operation or of other eye trouble or wore glasses—the differences being large enough to be statistically significant (table 23).

As expected, when the presence of uncorrected strabismus was found on the examination there was a significant association with a history of crossed eyes and eye operations, both for those with manifest and latent forms (table 24). Children with manifest strabismus were more likely than those with a latent condition to have a history of crossed eyes or previous eye operation. Nearly 53 percent of the children who have had a history of crossed eyes and about 46 percent of those who have had an eye operation for any reason were still found to have strabismus.

SUMMARY

This report contains the prevalence of abnormal eye conditions found on examination, heterophoria test results, and the history of eye problems as well as the extent of interrelationship of the eye examination and vision test findings among children aged 6-11 years in the United States, based on findings from the Health Examination Survey of 1963-65.

In this survey program a probability sample of 7,417 children was selected to represent the nearly 24 million noninstitutionalized children of this age in the United States. Of these the 7,119 or 96 percent examined were closely representative of the population from which they were drawn with respect to age, sex, race, region, and other demographic and socioeconomic variables.

Principal findings from this study include:

1. Nearly one-tenth, or an estimated 2.2 million, of these children were found on examination to have a disease condition or other abnormality in one or both eyes. The prevalence rates were slightly, but not significantly, lower among younger than older children and also among boys than girls.
2. Strabismus (manifest and latent) was the eye condition most frequently found. One child in 14, or 1.6 million, had such a problem. About one-third of these children had manifest strabismus or squint and the remainder a latent condition.
3. The prevalence of each of the three infectious or allergic conditions identified in the examination—blepharitis, conjunctivitis, or stye—was less than 1 percent.
4. From the vision tests, about two children out of five were found to have some marked degree of eye muscle imbalance (heterophoria) in the vertical or horizontal plane when the stimulus to binocular fusion was low.
5. At distance, significant deviations in the position of the binocular image were more likely to be ones of convergence (esophoria) or downward (hypophoria) than in some other direction. At near, because of the difference in the critical levels commonly used, relatively more of the children had a significant divergent deviation (exophoria) than convergent.
6. About one-eighth of the children rated as having significant heterophoria (eye muscle imbalance)

on the vision tests were considered by the examining pediatrician to have strabismus, either manifest or latent, since the examination detected only the more deviant conditions.

7. Children with defective visual acuity (less than 20/40 or 14/35) were substantially more likely than those with normal vision to have strabismus, either manifest of latent. The differential was more pronounced for manifest than for latent conditions. Heterophoria test results show a similar pattern of relationship to visual acuity.
8. The prevalence of defective color vision was higher among children with defective than among those with normal visual acuity.
9. The most frequent eye problems, past and present, reported for these children by their parents were visual acuity defects (10 percent wore glasses or contact lenses), symptoms of burning or itching around the eye (9 percent), specific infections or related conditions such as styes (9 percent), and frequent rubbing or blinking of eyes when reading (8 percent).

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Table 1. Prevalence rates for principal infectious and functional eye abnormalities observable on direct examination of the eye among children, by type of condition, age, and sex, with standard errors for totals: United States, 1963-65

Age and sex	Examination finding—one or both eyes							
	Any eye abnormality	Stye	Conjunctivitis	Blepharitis	Strabismus			Other eye condition
					Total	Manifest	Latent	
	Rate per 1,000 children							
Both sexes								
6-11 years	91.8	2.9	4.3	4.4	67.2	23.8	43.4	26.7
6 years	70.8	2.5	3.3	3.0	54.6	18.8	35.8	18.0
7 years	80.2	5.1	4.1	3.2	58.3	23.6	34.7	13.9
8 years	109.0	2.1	3.5	4.5	85.1	31.1	54.0	26.8
9 years	92.6	0.8	6.6	6.7	67.2	22.1	45.1	30.1
10 years	96.7	3.9	5.7	3.7	66.0	20.3	45.7	38.4
11 years	102.8	3.3	2.8	5.2	72.8	26.9	45.9	34.2
Boys								
6-11 years	86.1	2.9	5.8	3.5	60.0	24.0	36.0	27.2
6 years	67.1	3.3	4.9	4.4	50.8	25.6	25.2	21.1
7 years	64.7	2.5	8.2	0.9	43.9	15.6	28.3	14.0
8 years	94.5	4.2	5.3	1.0	71.2	32.5	38.7	16.3
9 years	90.6	-	7.4	5.6	63.2	19.1	44.1	31.2
10 years	93.9	1.9	4.6	2.0	63.3	23.7	39.6	41.9
11 years	108.1	5.3	4.4	7.2	68.8	27.8	41.0	40.4
Girls								
6-11 years	97.7	3.0	2.8	5.3	74.6	23.5	51.1	26.1
6 years	74.7	1.6	1.7	1.5	58.5	11.7	46.8	14.7
7 years	96.2	7.8	-	5.6	73.2	31.9	41.3	13.8
8 years	123.8	-	1.6	8.1	99.3	29.7	69.6	37.6
9 years	94.8	1.6	5.7	8.0	71.4	25.2	46.2	29.0
10 years	99.7	5.9	6.9	5.5	68.9	16.8	52.1	34.8
11 years	97.4	1.2	1.1	3.1	76.9	26.0	50.9	27.9
	Standard error							
Both sexes 6-11 years	23.70	0.60	0.80	1.40	10.30	2.40	7.90	3.10

Table 2. Number of children with principal infectious and functional eye abnormalities observable on direct examination of the eye among children, by type of condition, age, and sex: United States, 1963-65

Age and sex	Examination finding—one or both eyes							
	Any eye abnormality	Stye	Conjunctivitis	Blepharitis	Strabismus			Other eye condition
					Total	Manifest	Latent	
Both sexes	Number in thousands							
6-11 years	2,183	71	104	105	1,599	567	1,032	636
6 years	290	10	14	12	224	77	147	74
7 years	328	21	17	13	238	97	141	57
8 years	435	9	14	18	339	124	215	107
9 years	366	3	26	28	266	88	178	119
10 years	374	15	22	14	256	79	177	149
11 years	390	13	11	20	276	102	174	130
Boys								
6-11 years	1,040	35	71	42	725	291	434	330
6 years	139	7	10	9	106	53	53	44
7 years	135	5	17	2	91	33	58	29
8 years	192	9	11	2	144	66	78	33
9 years	182	-	15	11	127	39	88	63
10 years	184	4	9	4	125	47	78	83
11 years	208	10	9	14	132	53	79	78
Girls								
6-11 years	1,143	36	33	63	874	276	598	306
6 years	151	3	4	3	118	24	94	30
7 years	193	16	-	11	147	64	83	28
8 years	243	-	3	16	195	58	137	74
9 years	184	3	11	17	139	49	90	56
10 years	190	11	13	10	131	32	99	66
11 years	182	3	2	6	144	49	95	52

Table 3. Prevalence rates for multiple eye conditions observable on direct examination of the eye among children 6-11 years of age, by type of condition and sex, with corresponding standard errors: United States, 1963-65

Examination finding	Prevalence among children aged 6-11 years			Standard error of estimate		
	Total	Boys	Girls	Total	Boys	Girls
	Rate per 1,000 children					
Stye and conjunctivitis	0.1	0.2	-	0.10	0.20	-
Stye and blepharitis	0.2	0.2	0.2	0.10	0.20	0.20
Conjunctivitis and blepharitis	0.5	0.4	0.6	0.30	0.30	0.40
All three types of infections	0.1	0.2	-	0.10	0.20	-
Strabismus and another condition	8.0	6.7	9.4	*	*	*
All three types of infections and another condition	0.1	0.2	-	0.10	0.20	-
Strabismus and infection	0.1	0.2	-	*	*	-
All five conditions	0.1	0.2	-	*	*	-

Table 4. Proportion of children for whom the specific types of examination were used in detecting strabismus, by age and sex: United States, 1963-65

Age and sex	Test(s) used in detection				Strabismus detected only by			
	Observation	Moving light	Hirschberg	Screen	Observation	Moving light	Hirschberg	Screen
	Percent with strabismus							
Both sexes								
6-11 years	31.5	40.4	38.1	83.8	1.9	1.2	13.5	36.7
6 years	26.7	48.3	33.8	82.1	5.2	1.6	11.1	28.3
7 years	41.5	52.1	34.2	85.9	-	1.1	7.2	33.5
8 years	29.5	38.9	37.1	78.9	1.3	2.9	14.2	41.6
9 years	31.7	35.4	42.4	84.6	3.2	-	16.4	36.0
10 years	27.0	39.1	39.9	89.5	1.4	-	17.2	37.6
11 years	33.9	32.9	41.0	84.9	0.8	1.1	13.9	40.9
Boys								
6-11 years	34.6	41.1	42.0	80.8	2.6	1.0	13.6	33.9
6 years	34.1	44.4	38.9	68.8	8.0	3.4	13.1	22.7
7 years	29.6	47.5	29.8	92.0	-	-	7.3	36.6
8 years	38.6	41.0	49.5	70.3	3.1	2.3	22.4	30.9
9 years	30.6	32.2	42.9	88.6	1.7	-	14.5	43.5
10 years	28.0	32.7	40.2	86.1	2.9	-	15.8	41.7
11 years	45.7	52.5	47.2	85.6	-	-	6.3	29.3
Girls								
6-11 years	29.0	39.9	34.9	86.3	1.4	1.4	13.4	39.1
6 years	20.3	52.3	29.6	94.7	2.7	-	9.5	33.6
7 years	48.8	54.9	36.8	82.2	-	1.8	7.2	31.6
8 years	22.9	37.5	28.2	85.6	-	3.4	8.2	49.7
9 years	33.0	38.6	42.3	81.5	4.7	-	18.2	29.5
10 years	26.2	45.0	39.6	92.6	-	-	18.5	33.8
11 years	23.3	15.2	35.6	84.9	1.6	2.0	21.0	51.8

Table 5. Prevalence rates for strabismus among children, by type of condition, eye affected, age, and sex: United States, 1963-65

Age and sex	Manifest—eye affected		Latent—eye affected		Manifest—eye affected		Latent—eye affected		Both eyes affected	
	Right	Left	Right	Left	Right only	Left only	Right only	Left only	Manifest	Latent
	Rate per 1,000 children									
Both sexes										
6-11 years	13.6	13.8	34.5	33.4	10.0	10.2	10.0	8.9	3.6	24.5
6 years	8.6	12.3	28.5	30.0	6.5	10.2	5.8	7.3	2.1	22.7
7 years	16.0	11.3	29.0	25.1	12.4	7.7	9.6	5.7	3.6	19.4
8 years	17.7	20.4	42.3	43.1	10.7	13.4	10.8	11.6	7.0	31.5
9 years	11.8	11.4	33.5	31.3	10.8	10.4	13.8	11.6	1.0	19.7
10 years	9.6	14.5	38.1	35.4	5.9	10.8	10.3	7.6	3.7	27.8
11 years	17.9	13.1	36.3	35.8	13.8	9.0	10.0	9.5	4.1	26.3
Boys										
6-11 years	13.4	14.0	28.4	28.0	10.1	10.7	8.0	7.6	3.3	20.4
6 years	13.7	16.1	19.1	21.2	9.5	11.9	4.1	6.2	4.2	15.0
7 years	6.5	10.6	22.5	18.1	5.1	9.2	10.2	5.8	1.4	12.3
8 years	18.0	18.3	26.5	33.4	14.2	14.5	5.4	12.3	3.8	21.1
9 years	11.6	7.6	34.2	30.7	11.6	7.6	13.3	9.8	-	20.9
10 years	12.8	16.3	36.9	30.5	7.4	10.9	9.0	2.6	5.4	27.9
11 years	18.0	14.6	32.0	35.0	13.3	9.9	6.0	9.0	4.7	26.0
Girls										
6-11 years	13.8	13.7	40.9	39.0	9.9	9.8	12.1	10.2	3.9	28.8
6 years	3.4	8.4	38.1	39.2	3.4	8.4	7.5	8.6	-	30.6
7 years	25.8	11.9	35.8	32.4	20.0	6.1	8.9	5.5	5.8	26.9
8 years	17.4	22.7	58.5	53.1	7.1	12.4	16.5	11.1	10.3	42.0
9 years	12.0	15.2	32.8	31.9	10.1	13.3	14.2	13.3	1.9	18.6
10 years	6.2	12.6	39.4	40.5	4.2	10.6	11.6	12.7	2.0	27.8
11 years	17.9	11.7	40.6	36.7	14.4	8.2	14.2	10.3	3.5	26.4

Table 6. Percent of children with manifest strabismus, by direction of deviation of the eye affected, age, and sex, with total standard errors: United States, 1963-65

Age and sex	Direction of deviation													
	Manifest strabismus—right eye deviation							Manifest strabismus—left eye deviation						
	In	Out	Up	Down	In with up or down	Out with up or down	Other combination	In	Out	Up	Down	In with up or down	Out with up or down	Other combination
	Percent with manifest strabismus													
Both sexes														
6-11 years	39.3	32.4	6.2	-	12.4	3.1	6.6	54.1	16.8	4.5	0.8	6.6	3.7	13.5
6 years	20.6	48.5	10.1	-	9.0	-	11.8	75.1	9.2	7.5	-	8.2	-	-
7 years	49.5	6.9	4.0	-	14.2	15.4	9.9	30.3	16.5	-	-	18.4	7.5	27.3
8 years	53.4	18.0	3.2	-	25.4	-	-	43.7	21.4	9.0	3.1	2.6	7.6	12.5
9 years	28.4	53.3	10.2	-	-	-	8.1	61.7	5.6	8.4	-	8.4	-	15.9
10 years	25.4	54.1	10.8	-	9.7	-	-	56.1	20.3	-	-	5.9	4.6	13.1
11 years	39.5	37.2	4.3	-	8.9	-	10.1	62.8	23.0	-	-	-	-	14.2
Boys														
6-11 years	37.3	35.8	7.6	-	15.0	-	4.3	54.5	18.3	3.5	1.5	4.9	2.7	14.6
6 years	25.6	47.2	12.6	-	-	-	14.6	62.5	13.8	11.3	-	12.4	-	-
7 years	39.9	15.5	-	-	24.1	-	20.5	36.2	25.3	-	-	8.6	-	29.9
8 years	61.0	7.8	-	-	31.1	-	-	55.1	21.2	5.8	6.8	5.8	5.3	-
9 years	14.0	65.6	20.4	-	-	-	-	76.2	-	-	-	-	-	23.8
10 years	27.8	42.2	15.8	-	14.2	-	-	51.5	17.6	-	-	-	8.0	22.9
11 years	43.5	39.1	-	-	17.4	-	-	49.6	25.2	-	-	-	-	25.2
Girls														
6-11 years	41.3	28.9	4.8	-	9.8	6.2	8.9	53.9	15.1	5.5	-	8.5	4.8	12.3
6 years	-	53.5	-	-	46.5	-	-	100.0	-	-	-	-	-	-
7 years	52.1	4.7	5.1	-	11.6	19.4	7.1	24.8	8.5	-	-	27.4	14.3	25.0
8 years	45.2	28.8	6.7	-	19.3	-	-	34.2	21.6	11.6	-	-	9.6	23.0
9 years	42.9	41.0	-	-	-	-	16.1	54.1	8.5	12.7	-	12.8	-	11.9
10 years	20.3	79.7	-	-	-	-	-	62.4	23.9	-	-	13.7	-	-
11 years	35.5	35.2	8.7	-	-	-	20.6	79.8	20.2	-	-	-	-	-
	Standard error													
Both sexes 6-11 years	7.98	5.82	2.66	-	5.62	3.03	4.57	7.39	5.51	1.66	0.84	4.64	1.09	9.42

Table 7. Percent of children with manifest strabismus affecting both eyes, by direction of deviation of the eyes, age, and sex: United States, 1963-65

Age and sex	Direction of deviation of eyes								
	Both in	Right in, left out	Right in, left other	Right out, left in	Both out	Right out, left other	Left in, right other	Left out, right other	Both other
	Percent with manifest strabismus								
Both sexes									
6-11 years	23.6	9.6	19.3	14.4	17.6	-	16.5	-	-
6 years	-	-	-	28.2	30.8	-	52.1	-	-
7 years	21.2	14.6	42.9	-	-	-	26.4	-	-
8 years	36.7	7.3	24.4	10.1	15.8	-	8.4	-	-
9 years	-	-	-	-	-	-	100.0	-	-
10 years	50.1	-	25.5	-	26.7	-	-	-	-
11 years	-	27.1	-	47.1	28.7	-	-	-	-
Boys									
6-11 years	40.2	10.1	9.2	18.5	11.4	-	10.7	-	-
6 years	-	-	-	28.2	30.8	-	52.1	-	-
7 years	100.0	-	-	-	-	-	-	-	-
8 years	80.9	28.0	-	-	-	-	-	-	-
9 years	-	-	-	-	-	-	-	-	-
10 years	70.2	-	35.7	-	-	-	-	-	-
11 years	-	24.8	-	62.1	24.5	-	-	-	-
Girls									
6-11 years	9.5	9.2	28.0	10.7	23.0	-	21.6	-	-
6 years	-	-	-	-	-	-	-	-	-
7 years	-	18.5	54.6	-	-	-	-	-	-
8 years	21.3	-	33.0	13.7	21.3	-	33.5	-	-
9 years	-	-	-	-	-	-	11.4	-	-
10 years	-	-	-	-	100.0	-	100.0	-	-
11 years	-	34.7	-	34.7	39.0	-	-	-	-

Table 8. Percent of children with latent strabismus, by direction of deviation of the eye affected, age, and sex, with standard errors for totals: United States, 1963-65

Age and sex	Direction of deviation													
	Latent strabismus—right eye deviation							Latent strabismus—left eye deviation						
	In	Out	Up	Down	In with up or down	Out with up or down	Other combination	In	Out	Up	Down	In with up or down	Out with up or down	Other combination
	Percent with latent strabismus													
Both sexes														
6-11 years--	32.5	37.6	1.1	-	17.4	1.3	10.1	20.6	47.2	4.8	-	7.9	0.9	18.6
6 years----------	23.9	29.6	-	-	39.9	-	6.6	21.0	29.9	2.9	-	-	-	46.2
7 years----------	35.0	38.7	2.8	-	20.5	-	3.0	22.5	53.8	-	-	-	-	23.7
8 years----------	31.2	38.5	1.9	-	10.3	-	18.1	14.0	45.6	12.5	-	17.8	-	10.1
9 years----------	26.7	36.9	1.8	-	19.8	5.4	9.4	27.7	35.8	5.5	-	8.6	2.9	19.5
10 years---------	40.2	38.3	-	-	12.4	2.5	6.6	18.2	58.6	2.2	-	7.7	2.7	10.6
11 years---------	36.4	42.4	-	-	7.4	-	13.8	23.3	58.7	2.2	-	8.1	-	7.7
Boys														
6-11 years--	33.8	35.1	0.7	-	15.0	1.0	14.4	22.7	46.1	2.4	-	11.0	-	17.8
6 years----------	18.1	21.2	-	-	51.2	-	9.5	6.2	24.4	-	-	-	-	69.4
7 years----------	25.4	50.5	-	-	24.1	-	-	31.2	38.9	-	-	-	-	29.9
8 years----------	35.6	35.2	-	-	6.4	-	22.8	20.6	48.9	7.4	-	18.1	-	5.0
9 years----------	30.2	34.0	3.6	-	8.9	5.2	18.1	33.8	42.5	-	-	9.9	-	13.8
10 years---------	45.8	35.5	-	-	5.2	-	13.5	10.9	70.8	5.0	-	13.3	-	-
11 years---------	38.8	32.7	-	-	10.6	-	17.9	31.1	42.8	-	-	16.4	-	9.7
Girls														
6-11 years--	31.5	39.5	1.4	-	19.1	1.5	7.0	19.1	48.0	6.6	-	5.6	1.6	19.1
6 years----------	27.0	33.9	-	-	34.1	-	5.0	29.2	33.1	4.5	-	-	-	33.2
7 years----------	41.4	30.8	4.7	-	18.2	-	4.9	17.4	62.4	-	-	-	-	20.2
8 years----------	29.1	40.1	2.8	-	12.1	-	15.9	9.7	43.6	15.8	-	17.6	-	13.3
9 years----------	22.9	40.0	-	-	31.4	5.7	-	21.6	29.2	11.0	-	7.2	5.9	25.1
10 years---------	34.6	41.0	-	-	19.4	5.0	-	23.9	49.1	-	-	3.3	4.8	18.9
11 years---------	34.6	50.1	-	-	4.8	-	10.5	15.7	74.2	4.4	-	-	-	5.7
	Standard error													
Both sexes 6-11 years----------	10.21	10.93	0.76	-	12.66	1.12	5.56	6.61	13.01	2.49	-	4.69	0.78	13.85

Table 9. Percent of children with latent strabismus affecting both eyes, by direction of deviation of the eyes, age, and sex: United States, 1963-65

Age and sex	Direction of deviation of eyes								
	Both in	Right in, left out	Right in, left other	Right out, left in	Both out	Right out, left other	Left in, right other	Left out, right other	Both other
	Percent with latent strabismus								
Both sexes									
6-11 years----------	11.0	35.3	2.3	19.8	18.5	25.7	12.4	51.8	23.4
6 years----------	-	19.7	4.1	10.8	11.5	58.0	10.8	31.1	54.0
7 years----------	2.6	44.3	-	11.5	15.7	30.8	14.1	51.5	30.8
8 years----------	28.0	33.3	2.6	30.1	17.6	15.5	9.3	50.9	12.9
9 years----------	8.0	27.6	3.1	32.2	13.3	31.4	24.2	34.5	28.2
10 years---------	5.6	43.9	-	12.2	31.1	13.3	6.6	75.0	13.3
11 years---------	14.8	42.8	3.9	20.9	19.3	13.6	13.5	62.1	9.7
Boys									
6-11 years----------	16.2	30.9	2.5	21.0	24.2	23.1	8.5	53.1	20.6
6 years----------	-	-	12.2	-	23.2	78.1	-	23.2	65.8
7 years----------	-	45.8	-	11.1	-	44.8	11.1	45.8	44.8
8 years----------	39.9	22.7	-	29.1	31.0	8.1	10.8	53.7	8.1
9 years----------	15.0	37.7	5.9	24.4	25.0	20.9	9.4	50.8	15.0
10 years---------	11.2	40.7	-	17.4	37.9	5.5	6.2	78.5	5.5
11 years---------	22.5	35.7	-	35.3	17.6	13.3	12.8	53.4	13.3
Girls									
6-11 years----------	7.1	38.5	2.1	18.9	14.3	47.6	15.2	50.9	25.4
6 years----------	-	30.0	-	16.5	5.7	48.8	16.5	35.7	48.8
7 years----------	3.8	44.3	-	11.8	23.4	24.8	15.7	55.1	24.8
8 years----------	22.3	39.1	4.0	31.0	10.9	19.5	8.7	50.0	15.5
9 years----------	-	16.0	-	40.9	-	43.3	40.9	16.0	43.3
10 years---------	-	48.1	-	7.2	24.7	21.7	7.2	72.8	21.7
11 years---------	7.5	50.7	7.9	7.0	21.4	14.1	14.5	72.1	6.2

Table 10. Percentage distribution of children by degree of distance and near heterophoria found on test and age: United States, 1963-65

Phoria scale	(Δ) Prism diopters of deviation	Age in years					
		6	7	8	9	10	11
LATERAL—DISTANCE		Percentage distribution					
Total------		100.0	100.0	100.0	100.0	100.0	100.0
Esophoria							
0	11+	0.6	0.6	1.8	1.3	1.7	1.4
1	10	0.4	1.4	0.7	1.3	0.5	0.5
2	9	0.4	0.8	0.8	0.7	0.8	0.7
3	8	2.1	3.0	3.6	2.3	1.5	2.0
4	7	2.0	1.3	0.8	0.9	1.6	0.8
5	6	2.2	3.2	3.4	2.2	3.0	3.0
6	5	7.0	2.9	3.7	3.5	2.5	4.0
7	4	11.3	11.3	11.9	9.9	11.7	8.2
8	3	9.4	7.0	8.6	7.6	5.8	8.9
9	2	17.8	25.9	21.4	23.0	24.2	24.4
10	1	9.8	10.2	12.6	12.9	13.7	15.1
11	0	22.5	20.3	17.7	22.3	20.4	18.6
Exophoria							
12	1	7.5	6.7	6.0	6.9	7.5	5.9
13	2	3.3	2.4	4.4	2.6	2.9	3.1
14	3	0.8	1.0	0.6	0.7	0.7	0.9
15	4	1.0	0.8	0.4	0.4	0.5	1.1
16	5	0.7	0.2	-	0.3	0.1	0.2
17	6	0.2	0.4	0.4	0.1	0.2	0.1
18	7	0.2	0.1	0.2	0.3	-	0.1
19	8	0.2	-	0.2	0.1	-	0.1
20	9	-	0.1	0.1	0.2	0.3	0.2
21	10	0.6	0.4	0.5	0.4	0.3	0.5
22	11+	0.1	-	0.2	0.1	0.1	0.2
VERTICAL—DISTANCE							
Total------		100.0	100.0	100.0	100.0	100.0	100.0
Hypophoria							
0	2.5+	3.1	1.4	1.0	1.1	1.1	0.4
1	2.0	5.3	4.3	2.2	2.1	1.5	1.4
2	1.5	2.9	1.0	0.8	1.3	0.7	1.1
3	1.0	3.6	2.8	3.2	2.7	2.4	2.0
4	0.5	11.3	15.2	14.2	13.5	13.4	11.9
5	0	38.3	41.2	49.5	54.3	58.2	59.7

Phoria scale	(Δ) Prism diopters of deviation	Age in years					
		6	7	8	9	10	11
VERTICAL—DISTANCE—Con.		Percentage distribution					
Hyperphoria							
6	0.5	13.2	16.8	14.7	13.8	14.2	15.6
7	1.0	4.7	4.4	3.0	2.1	2.2	2.4
8	1.5	6.4	3.2	3.5	2.9	2.1	1.6
9	2.0	7.3	6.1	5.1	4.9	2.9	2.8
10	2.5+	3.9	3.6	2.8	1.3	1.3	1.1
LATERAL-NEAR							
Total------		100.0	100.0	100.0	100.0	100.0	100.0
Esophoria							
0	13+	1.2	0.7	1.8	1.6	1.5	1.1
1	12	0.5	0.8	0.3	0.7	0.1	0.6
2	11	1.0	1.0	0.9	1.2	0.9	0.5
3	10	1.8	1.9	2.4	1.4	0.8	1.5
4	9	0.5	0.5	0.2	0.1	0.3	0.3
5	8	1.4	0.8	0.7	0.6	0.7	0.3
6	7	1.1	0.5	0.4	0.3	0.5	0.5
7	6	2.7	2.8	1.7	0.5	1.7	1.5
8	5	2.2	1.0	0.7	1.8	1.6	1.6
9	4	3.2	3.4	3.9	4.9	4.0	4.2
10	3	2.1	2.1	2.6	3.5	2.7	3.5
11	2	12.0	7.3	9.7	10.8	8.2	9.6
12	1	8.0	6.3	6.9	7.1	7.7	7.6
13	0	13.1	18.0	15.2	16.0	14.4	12.5
Exophoria							
14	1	4.9	4.9	5.6	4.4	6.5	7.3
15	2	14.0	16.1	15.0	13.0	13.7	11.5
16	3	3.7	3.7	4.0	4.1	4.3	4.2
17	4	11.3	13.9	10.7	10.0	9.4	8.9
18	5	2.4	2.4	2.6	3.2	4.7	3.8
19	6	5.1	4.2	6.1	4.8	5.0	4.2
20	7	1.4	0.7	1.8	1.9	1.3	2.5
21	8	2.1	1.8	1.9	2.5	2.4	2.6
22	9	0.1	0.5	0.8	0.6	1.0	1.3
23	10	1.4	1.6	1.2	1.7	2.0	2.2
24	11	0.1	0.2	0.4	0.3	0.8	0.2
25	12	0.9	1.0	0.8	0.9	0.9	1.5
26	13	0.2	-	-	-	0.6	0.1
27	14	0.2	0.5	0.3	0.6	0.9	1.2
28	15	-	-	0.2	0.2	-	0.1
29	16	0.1	0.6	0.4	0.5	0.7	1.1
30	17	0.2	-	-	0.1	0.2	0.4
31	18	0.5	0.5	0.4	0.3	0.4	1.0
32	19	-	-	0.1	0.1	-	0.2
33	20	-	-	0.1	0.3	-	0.2
34	21+	0.6	0.3	0.2	-	0.1	0.2

Table 11. Percent of children with significant distance and near heterophoria found on test, by age and sex: United States, 1963-65

Age and sex	Lateral phoria—distance			Vertical phoria—distance			Lateral phoria—near		
	Esophoria (5Δ+)	Normal (0-4Δ)	Exophoria (5Δ+)	Hypophoria (1.5Δ+)	Normal (0-1.0Δ)	Hyperphoria (1.5Δ+)	Esophoria (6Δ+)	Normal (5Δ Lt 9Δ Rt)	Exophoria (10Δ+)
	Percent								
Both sexes									
6-11 years-	13.2	85.4	1.4	5.4	84.1	10.5	7.8	86.7	5.5
6 years	14.7	83.4	1.9	11.3	71.1	17.6	10.2	85.6	4.2
7 years	13.2	85.6	1.2	6.7	80.4	12.9	9.0	86.3	4.7
8 years	14.8	83.6	1.6	4.0	84.6	11.4	8.4	87.5	4.1
9 years	12.2	86.3	1.5	4.5	86.4	9.1	6.4	88.6	5.0
10 years	11.6	87.4	1.0	3.3	90.4	6.3	6.5	86.9	6.6
11 years	12.4	86.2	1.4	2.9	91.6	5.5	6.3	85.3	8.4
Boys									
6-11 years-	12.7	86.0	1.3	5.3	84.1	10.6	8.4	86.3	5.3
6 years	14.6	83.2	2.2	11.0	68.5	20.5	11.2	85.3	3.5
7 years	11.9	87.0	1.1	6.5	79.3	14.2	9.4	84.8	5.8
8 years	13.9	84.3	1.8	4.3	85.4	10.3	8.7	87.1	4.2
9 years	12.1	86.7	1.2	3.8	87.3	8.9	7.0	88.1	4.9
10 years	11.8	87.2	1.0	3.4	91.7	4.9	7.4	87.1	5.5
11 years	12.1	87.3	0.6	3.0	92.3	4.7	6.9	85.1	8.0
Girls									
6-11 years-	13.5	85.0	1.5	5.6	84.0	10.4	7.1	87.3	5.6
6 years	14.7	83.9	1.4	11.6	73.6	14.8	9.2	86.6	4.2
7 years	14.5	84.2	1.3	6.9	81.4	11.7	8.3	88.1	3.6
8 years	15.9	82.5	1.6	3.8	83.7	12.5	8.4	87.2	4.4
9 years	12.4	85.9	1.7	5.1	85.5	9.4	5.6	89.1	5.3
10 years	11.2	87.9	0.9	3.3	88.8	7.9	5.8	86.8	7.4
11 years	12.3	85.6	2.1	2.8	90.8	6.4	5.6	85.9	8.5

Table 12. Number of children with significant distance and near heterophoria found on test, by age and sex: United States, 1963-65

Age and sex	Lateral phoria—distance			Vertical phoria—distance			Lateral phoria—near		
	Esophoria (5Δ+)	Normal (0-4Δ+)	Exophoria (5Δ+)	Hypophoria (1.5Δ+)	Normal (0-1.0Δ)	Hyperphoria (1.5Δ+)	Esophoria (6Δ+)	Normal (5Δ Lt 9Δ Rt)	Exophoria (10Δ+)
	Number in thousands								
Both sexes									
6-11 years-	3,124	20,296	335	1,307	19,895	2,516	1,867	20,615	1,276
6 years	600	3,426	72	460	2,900	724	418	3,527	154
7 years	538	3,496	47	272	3,281	527	363	3,518	193
8 years	592	3,324	66	160	3,365	452	337	3,482	167
9 years	484	3,412	61	179	3,413	362	253	3,500	200
10 years	446	3,369	37	126	3,483	243	256	3,353	248
11 years	464	3,269	52	110	3,453	209	240	3,235	314
Boys									
6-11 years-	1,537	10,365	162	649	10,113	1,290	1,024	10,411	637
6 years	305	1,732	45	228	1,418	427	234	1,777	72
7 years	245	1,807	22	135	1,647	293	195	1,753	120
8 years	281	1,704	37	86	1,726	207	174	1,768	83
9 years	243	1,743	26	77	1,756	179	141	1,772	99
10 years	231	1,700	20	65	1,798	94	145	1,707	108
11 years	232	1,679	12	58	1,768	90	135	1,634	155
Girls									
6-11 years-	1,587	9,931	173	658	9,782	1,226	843	10,204	639
6 years	295	1,694	27	232	1,482	297	184	1,750	82
7 years	292	1,689	25	137	1,634	235	168	1,765	73
8 years	311	1,620	29	74	1,639	245	163	1,714	84
9 years	241	1,669	35	102	1,657	183	112	1,728	101
10 years	215	1,668	17	61	1,685	148	111	1,646	140
11 years	233	1,591	40	52	1,685	118	105	1,601	159

Table 13. Percent of children with either form of strabismus showing significant distance and near heterophoria on test, by age and sex: United States, 1963-65

Age and sex	Lateral phoria—distance			Vertical phoria—distance			Lateral phoria—near		
	Esophoria (5Δ+)	Normal (0–4Δ)	Exophoria (5Δ+)	Hypophoria (1.5Δ+)	Normal (0–1.0Δ)	Hyperphoria (1.5Δ+)	Esophoria (6Δ+)	Normal (5Δ Lt 9Δ Rt)	Exophoria (10Δ+)
	Percent								
Both sexes									
6-11 years	29.9	65.6	4.5	13.4	71.3	15.3	23.0	64.1	12.9
6 years	33.9	57.5	8.6	20.2	56.0	23.8	23.5	69.0	7.5
7 years	26.0	72.2	1.8	17.1	65.6	17.3	26.2	66.8	7.0
8 years	32.0	63.6	4.4	9.6	71.7	18.7	26.5	60.4	13.1
9 years	37.8	58.3	3.9	9.2	78.3	12.5	22.6	69.5	7.9
10 years	25.0	72.8	2.2	14.6	75.8	9.6	18.8	59.2	22.0
11 years	24.1	69.6	6.3	12.5	77.1	10.4	19.9	61.8	18.3
Boys									
6-11 years	31.3	65.6	3.1	15.8	73.5	10.7	21.2	67.0	11.8
6 years	42.6	52.3	5.1	23.5	61.3	15.2	27.2	63.3	9.5
7 years	29.3	68.3	2.4	18.0	64.3	17.7	14.3	82.1	3.6
8 years	32.7	65.3	2.0	8.3	79.4	12.3	21.6	66.5	11.9
9 years	35.3	59.3	5.4	15.7	76.3	8.0	22.7	71.4	5.9
10 years	22.4	75.8	1.8	15.2	70.9	13.9	19.8	61.6	18.6
11 years	26.4	71.6	2.0	16.7	83.3	-	20.2	61.4	18.4
Girls									
6-11 years	28.7	65.6	5.7	11.5	69.4	19.1	24.6	61.7	13.7
6 years	26.0	62.3	11.7	17.3	51.2	31.5	20.2	74.0	5.8
7 years	24.0	74.6	1.4	16.6	66.3	17.1	33.4	57.5	9.1
8 years	31.6	62.1	6.3	10.5	66.1	23.4	30.1	56.0	13.9
9 years	40.0	57.4	2.6	3.3	80.2	16.5	22.6	67.7	9.7
10 years	27.5	69.9	2.6	14.0	80.6	5.4	17.9	56.9	25.2
11 years	21.9	67.9	10.2	8.6	71.4	20.0	19.6	62.2	18.2

Table 14. Percent of children with manifest strabismus showing significant distance and near heterophoria on test, by age and sex: United States, 1963-65

Age and sex	Lateral phoria—distance			Vertical phoria—distance			Lateral phoria—near		
	Esophoria (5Δ+)	Normal (0–4Δ)	Exophoria (5Δ+)	Hypophoria (1.5Δ+)	Normal (0–1.0Δ)	Hyperphoria (1.5Δ+)	Esophoria (6Δ+)	Normal (5Δ Lt 9Δ Rt)	Exophoria (10Δ+)
	Percent								
Both sexes									
6-11 years	43.1	53.0	3.9	23.7	58.9	17.4	36.5	54.4	9.1
6 years	44.2	52.5	3.3	20.8	62.1	17.1	25.1	65.6	9.3
7 years	35.4	62.3	2.3	36.6	48.8	14.6	40.2	55.9	3.9
8 years	46.7	48.8	4.5	13.9	62.6	23.5	41.9	48.1	10.0
9 years	55.0	45.0	-	20.0	65.6	14.4	45.4	43.4	11.2
10 years	45.4	47.5	7.1	28.8	60.7	10.5	45.5	46.2	8.3
11 years	33.2	60.6	6.2	24.9	54.3	20.8	19.9	68.7	11.4
Boys									
6-11 years	42.7	54.9	2.4	25.2	63.9	10.9	32.8	61.7	5.5
6 years	45.0	50.2	4.8	10.8	71.0	18.2	31.4	55.1	13.5
7 years	31.7	61.5	6.8	33.7	51.3	15.0	34.0	66.0	-
8 years	36.4	63.6	-	9.6	73.9	16.5	27.3	67.2	5.5
9 years	60.9	39.1	-	37.3	62.7	-	38.6	61.4	-
10 years	48.6	46.5	4.9	40.6	46.3	13.1	48.6	44.5	6.9
11 years	36.8	63.2	-	31.0	69.0	-	22.4	73.9	3.7
Girls									
6-11 years	43.5	51.0	5.5	22.2	53.7	24.1	40.3	46.9	12.8
6 years	42.4	57.6	-	43.3	42.1	14.6	11.0	89.0	-
7 years	37.3	62.7	-	38.1	47.5	14.4	43.1	51.2	5.7
8 years	58.4	32.0	9.6	18.5	50.4	31.1	58.4	26.6	15.0
9 years	50.4	49.6	-	6.4	67.8	25.8	50.7	29.3	20.0
10 years	40.8	48.9	10.3	11.6	81.6	6.8	40.9	48.8	10.3
11 years	29.2	57.7	13.1	18.1	37.6	44.3	16.8	62.7	20.5

Table 15. Percent of children with latent strabismus, by degree of distance and near heterophoria on test, age, and sex: United States, 1963-65

Age and sex	Lateral phoria—distance			Vertical phoria—distance			Lateral phoria—near		
	Esophoria (5^{Δ}_{+})	Normal ($0-4^{\Delta}$)	Exophoria (5^{Δ}_{+})	Hypophoria (1.5^{Δ}_{+})	Normal ($0-1.0^{\Delta}$)	Hyperphoria (1.5^{Δ}_{+})	Esophoria (6^{Δ}_{+})	Normal (5^{Δ} Lt. 9^{Δ} Rt.)	Exophoria (10^{Δ}_{+})
	Percent								
Both sexes									
6-11 years-	22.6	72.6	4.8	7.8	78.0	14.2	15.7	69.4	14.9
6 years----------	28.5	60.2	11.3	20.0	52.7	27.3	22.6	70.8	6.6
7 years----------	19.6	79.0	1.4	3.8	77.0	19.2	17.0	73.9	9.1
8 years----------	23.6	72.0	4.4	7.1	76.9	16.0	17.6	67.5	14.9
9 years----------	29.3	64.8	5.9	3.9	84.6	11.5	11.5	82.3	6.2
10 years---------	15.7	84.3	-	8.1	82.7	9.2	6.9	65.0	28.1
11 years---------	18.6	75.1	6.3	5.5	89.9	4.6	19.9	57.9	22.2
Boys									
6-11 years-	23.6	72.9	3.5	9.5	79.9	10.6	13.4	70.6	16.0
6 years----------	40.3	54.3	5.4	36.4	51.4	12.2	22.9	71.7	5.4
7 years----------	28.0	72.0	-	9.2	71.6	19.2	4.2	90.3	5.5
8 years----------	29.6	66.8	3.6	7.2	83.9	8.9	16.8	65.9	17.3
9 years----------	24.2	68.1	7.7	6.3	82.2	11.5	15.8	75.7	8.5
10 years---------	6.6	93.4	-	-	85.6	14.4	2.4	71.9	25.7
11 years---------	19.2	77.4	3.4	7.2	92.8	-	18.7	53.0	28.3
Girls									
6-11 years-	21.8	72.4	5.8	6.6	76.6	16.8	17.4	68.5	14.1
6 years----------	21.9	63.5	14.6	10.8	53.4	35.8	22.5	70.3	7.2
7 years----------	13.7	83.8	2.5	-	80.8	19.2	26.0	62.3	11.7
8 years----------	20.1	75.1	4.8	7.0	72.8	20.2	18.0	68.6	13.4
9 years----------	34.3	61.7	4.0	1.6	86.9	11.5	7.2	88.8	4.0
10 years---------	23.1	76.9	-	14.7	80.4	4.9	10.4	59.6	30.0
11 years---------	18.2	73.1	8.7	4.1	87.6	8.3	20.9	62.0	17.1

Table 16. Prevalence rates for manifest and latent strabismus among children with distance binocular visual acuity of 20/20 or better, 20/40 or less, and less than 20/40 and percent of all children with these levels of acuity, by age and sex: United States, 1963-65

Age and sex	Distance acuity											
	Total with strabismus			Manifest strabismus			Latent strabismus			All children		
	20/20 or better	20/40 or less	Less than 20/40	20/20 or better	20/40 or less	Less than 20/40	20/20 or better	20/40 or less	Less than 20/40	20/20 or better	20/40 or less	Less than 20/40
	Rate per 100 children											
Both sexes												
6-11 years--	5.6	13.1	13.1	1.7	6.1	5.8	3.9	7.0	7.3	74.8	11.1	7.3
6 years----------	4.9	12.3	17.4	1.4	5.5	7.3	3.5	6.8	10.1	72.7	7.4	2.3
7 years----------	5.2	11.7	13.8	1.8	8.7	10.8	3.4	3.0	2.9	71.6	9.3	5.1
8 years----------	6.8	18.6	17.4	2.1	10.0	8.8	4.7	8.7	8.6	75.9	9.1	5.8
9 years----------	5.3	10.8	8.9	1.6	3.5	4.2	3.7	7.3	4.7	78.1	10.2	6.6
10 years----------	5.1	14.1	14.3	1.8	2.6	2.1	3.3	11.5	12.2	77.8	13.4	10.5
11 years----------	6.1	12.1	11.6	1.6	7.3	6.2	4.5	4.8	5.4	73.1	17.2	13.5
Boys												
6-11 years--	5.2	12.3	10.0	1.8	7.1	5.6	3.4	5.1	4.4	77.0	10.3	6.6
6 years----------	4.6	20.3	21.1	2.0	12.4	15.2	2.6	7.9	5.9	78.2	6.6	2.3
7 years----------	3.6	11.8	10.7	0.6	9.1	8.2	3.0	2.7	2.5	71.5	9.1	5.5
8 years----------	5.8	15.0	11.1	2.2	11.1	7.6	3.6	3.8	3.5	76.5	9.4	5.2
9 years----------	5.6	10.0	6.4	1.4	3.9	3.4	4.2	6.1	3.0	81.5	9.1	6.0
10 years----------	6.0	7.2	6.3	2.5	1.9	1.3	3.5	5.3	5.0	80.0	11.6	8.7
11 years----------	5.8	13.0	12.1	1.9	7.3	6.1	3.9	5.7	6.0	74.7	16.1	12.4
Girls												
6-11 years--	5.9	13.9	15.8	1.7	5.3	6.1	4.2	8.6	9.7	72.4	11.9	7.9
6 years----------	5.2	5.9	13.9	0.8	-	-	4.4	5.9	13.9	66.9	8.3	2.4
7 years----------	6.8	11.7	17.9	3.1	8.4	14.4	3.7	3.3	3.5	71.6	9.5	4.7
8 years----------	7.8	22.9	22.8	2.0	8.8	9.8	5.8	14.1	12.9	75.2	9.0	6.6
9 years----------	5.1	11.6	11.2	1.8	3.2	5.0	3.3	8.4	6.2	74.4	11.5	7.5
10 years----------	4.1	19.6	20.2	1.0	3.1	2.6	3.1	16.5	17.6	75.4	15.3	12.4
11 years----------	6.5	11.4	11.3	1.3	7.4	6.3	5.2	4.0	5.0	71.4	18.3	14.6

Table 17. Prevalence rates for manifest and latent strabismus among children with near binocular visual acuity of 14/14 or better and less than 14/35 and percent of all children with those levels of acuity, by age and sex: United States, 1963-65

Age and sex	Near acuity							
	Total with strabismus		Manifest strabismus		Latent strabismus		All children	
	14/14 or better	Less than 14/35	14/14 or better	Less than 14/35	14/14 or better	Less than 14/35	14/14 or better	Less than 14/35
	Rate per 100 children							
Both sexes								
6-11 years--	5.5	16.5	1.6	9.9	3.9	6.6	72.6	2.3
6 years---------	5.0	20.5	1.5	4.3	3.5	16.2	75.9	1.5
7 years---------	4.7	15.9	1.8	15.9	2.8	-	60.8	2.5
8 years---------	6.5	23.1	1.8	14.9	4.7	8.2	68.1	2.7
9 years---------	5.3	17.5	1.2	9.8	4.0	7.7	74.4	1.9
10 years--------	5.5	16.1	1.6	-	3.9	16.1	78.3	2.1
11 years--------	6.2	10.6	1.8	10.6	4.4	-	78.9	3.5
Boys								
6-11 years--	4.9	9.2	1.6	7.2	3.3	1.9	75.3	2.3
6 years---------	4.5	18.9	2.0	9.1	2.5	9.8	79.9	1.4
7 years---------	3.7	5.8	0.8	5.8	2.9	-	63.6	2.3
8 years---------	4.5	12.9	2.2	12.9	2.2	-	69.3	2.6
9 years---------	5.1	10.0	1.0	-	4.2	10.0	77.8	1.4
10 years--------	5.7	-	1.8	-	3.9	-	81.3	1.9
11 years--------	5.9	10.2	1.8	10.2	4.0	-	80.7	4.1
Girls								
6-11 years--	6.2	23.7	1.6	12.5	4.6	11.2	69.8	2.4
6 years---------	5.5	22.0	0.9	-	4.6	22.0	71.9	1.5
7 years---------	5.8	25.7	3.0	25.7	2.8	-	57.9	2.6
8 years---------	8.6	33.2	1.3	17.0	7.3	16.2	66.9	2.9
9 years---------	5.4	22.8	1.5	16.1	3.9	6.7	71.0	2.2
10 years--------	5.2	29.3	1.3	-	3.9	29.3	75.2	2.4
11 years--------	6.5	11.7	1.7	11.7	4.8	-	76.9	2.9

Table 18. Prevalence rates for eye muscle imbalance and normal balance on test at distance among children with distance binocular visual acuity of 20/20 or better, 20/40 or less, and less than 20/40, by age and sex: United States, 1963-65

Age and sex	Esophoria			Normal lateral			Exophoria		
	20/20 or better	20/40 or less	Less than 20/40	20/20 or better	20/40 or less	Less than 20/40	20/20 or better	20/40 or less	Less than 20/40
	Rate per 100 children								
Both sexes									
6-11 years-	11.5	21.5	19.7	87.3	76.0	77.7	1.3	2.6	2.7
6 years--------	13.4	20.0	13.9	84.8	78.2	82.8	1.9	2.9	6.2
7 years--------	12.4	22.5	27.3	86.7	76.3	72.0	0.9	2.0	1.9
8 years--------	13.4	21.2	15.8	85.3	74.0	82.9	1.4	5.5	2.3
9 years--------	9.7	24.6	23.4	89.0	73.2	73.1	1.3	3.1	4.7
10 years-------	9.5	21.2	18.9	89.5	78.4	80.5	1.0	0.6	0.8
11 years-------	10.7	20.5	18.6	88.4	77.6	78.8	1.0	2.4	3.1
Boys									
6-11 years-	11.6	20.8	17.0	87.1	77.2	81.6	1.2	2.3	1.8
6 years--------	13.7	26.0	28.7	84.5	71.9	69.2	2.0	4.0	5.5
7 years--------	12.3	12.7	10.2	87.0	87.2	89.1	0.8	2.1	3.6
8 years--------	12.5	25.6	16.3	86.3	67.0	80.1	1.3	8.7	5.2
9 years--------	10.1	24.7	18.8	88.8	76.0	81.8	1.2	1.1	1.7
10 years-------	10.5	21.7	18.3	88.4	79.7	83.1	1.3	-	-
11 years-------	10.8	18.3	17.0	88.8	82.5	83.8	0.6	-	-
Girls									
6-11 years-	11.4	22.2	22.1	87.4	75.2	74.8	1.3	2.9	3.5
6 years--------	13.0	15.3	-	85.4	83.8	95.6	1.8	2.0	6.9
7 years--------	12.6	32.8	48.7	86.5	67.0	53.6	1.0	1.9	-
8 years--------	14.3	16.9	15.7	84.4	83.0	86.5	1.4	2.1	-
9 years--------	9.4	24.8	27.5	89.4	71.6	66.7	1.4	4.7	7.3
10 years-------	8.5	21.3	19.7	90.9	78.8	80.2	0.8	1.1	1.4
11 years-------	10.5	22.5	20.1	88.3	73.6	75.0	1.3	4.6	5.7

Table 18. Prevalence rates for eye muscle imbalance and normal balance on test at distance among children with distance binocular visual acuity of 20/20 or better, 20/40 or less, and less than 20/40, by age and sex: United States, 1963-65—Con.

Age and sex	Hypophoria			Normal vertical			Hyperphoria		
	20/20 or better	20/40 or less	Less than 20/40	20/20 or better	20/40 or less	Less than 20/40	20/20 or better	20/40 or less	Less than 20/40
	Rate per 100 children								
Both sexes									
6-11 years-	20.0	30.9	30.9	52.5	40.1	39.4	27.5	29.1	29.9
6 years--------	25.7	22.3	21.1	40.2	35.5	33.3	34.1	43.3	48.6
7 years--------	25.3	24.7	20.7	41.9	37.3	34.4	33.1	38.8	46.1
8 years--------	20.5	28.7	22.9	50.2	39.7	43.1	29.4	32.3	35.1
9 years--------	18.2	41.3	44.3	57.1	38.7	31.4	24.7	20.9	25.4
10 years-------	17.1	31.4	31.8	62.1	43.4	42.1	21.0	25.5	26.5
11 years-------	13.3	33.7	33.6	63.9	43.2	43.9	22.8	23.5	23.0
Boys									
6-11 years-	20.0	32.7	30.4	53.1	36.1	36.3	26.9	31.4	33.5
6 years--------	23.8	29.8	20.8	39.0	22.8	22.8	37.4	49.4	59.9
7 years--------	25.1	21.9	11.2	43.5	35.8	39.6	31.5	44.3	52.1
8 years--------	21.2	39.6	31.7	48.9	30.7	33.4	30.0	31.0	36.5
9 years--------	16.4	40.0	44.1	60.9	32.5	19.5	22.8	29.2	38.7
10 years-------	19.2	28.4	27.7	62.4	45.3	45.2	18.6	27.9	28.7
11 years-------	14.3	37.0	37.1	64.9	42.6	42.8	21.1	21.2	20.8
Girls									
6-11 years-	20.1	29.4	31.5	51.8	43.8	42.2	28.2	27.1	26.8
6 years--------	28.1	16.4	21.3	41.8	46.0	43.2	30.2	38.7	37.9
7 years--------	25.5	28.0	32.8	40.2	39.5	29.2	34.9	34.1	40.4
8 years--------	19.8	17.4	16.1	51.5	50.2	51.6	28.8	34.3	34.5
9 years--------	20.3	42.8	45.1	52.9	44.2	41.8	26.9	14.1	14.6
10 years-------	14.8	34.5	35.4	61.8	42.7	40.6	23.6	24.0	25.3
11 years-------	12.3	30.9	30.5	63.1	44.0	45.1	24.8	25.7	25.0

Table 19. Prevalence rates for lateral eye muscle imbalance and normal balance on test at near among children with near binocular visual acuity of 14/14 or better and less than 14/35, by age and sex: United States, 1963-65

Age and sex	Esophoria		Normal lateral		Exophoria	
	14/14 or better	Less than 14/35	14/14 or better	Less than 14/35	14/14 or better	Less than 14/35
	Rate per 100 children					
Both sexes						
6-11 years	8.0	20.2	75.8	37.4	16.2	42.8
6 years	12.6	3.9	73.4	60.1	14.0	38.8
7 years	8.2	40.9	77.7	45.1	14.1	15.4
8 years	6.7	24.8	77.4	48.2	15.8	28.5
9 years	6.4	16.6	77.3	33.2	16.3	52.6
10 years	6.4	23.7	75.1	26.8	18.5	50.9
11 years	7.2	8.9	74.7	23.3	18.1	68.7
Boys						
6-11 years	8.6	18.4	77.0	34.9	14.4	47.1
6 years	11.6	8.1	76.4	77.5	12.0	20.0
7 years	8.5	24.4	79.0	53.5	12.5	24.4
8 years	7.2	27.3	78.2	44.8	14.6	29.4
9 years	7.0	25.6	78.3	25.6	14.7	58.9
10 years	7.6	11.5	76.4	18.2	16.0	71.2
11 years	9.2	15.0	74.3	15.4	16.5	70.6
Girls						
6-11 years	7.3	21.9	74.5	39.9	18.2	38.7
6 years	13.7	-	69.9	44.3	16.4	55.9
7 years	7.8	57.1	76.3	38.0	15.9	7.2
8 years	6.3	23.0	76.6	52.2	17.1	28.2
9 years	5.7	11.9	76.2	39.3	18.1	51.3
10 years	5.0	34.4	73.7	34.4	21.3	33.0
11 years	5.1	-	75.0	35.9	19.8	68.6

Table 20. Prevalence rates for defective color vision among children with specified levels of at least normal and defective distance and near binocular visual acuity, by age and sex: United States, 1963-65

Age and sex	Defective color vision					
	Total	Visual acuity				
		Distance			Near	
		20/20 or better	20/40 or less	Less than 20/40	14/14 or better	Less than 14/35
	Rate per 100 children					
Both sexes						
6-11 years	4.8	4.5	7.4	8.2	4.6	7.8
6 years	6.3	6.6	9.8	12.3	6.2	-
7 years	4.2	4.1	4.9	9.0	4.2	13.1
8 years	4.	3.8	5.5	7.2	3.8	-
9 years	4.5	4.0	8.4	9.9	4.3	17.9
10 years	4.9	4.7	4.7	5.4	4.6	5.2
11 years	4.7	3.6	10.2	9.2	4.2	10.0
Boys						
6-11 years	8.1	7.4	13.4	15.0	7.6	10.0
6 years	9.9	10.1	19.0	16.4	9.2	-
7 years	6.6	6.6	4.5	7.6	6.8	6.3
8 years	7.8	6.4	10.7	16.2	6.9	-
9 years	7.7	7.1	14.2	14.9	7.2	26.5
10 years	8.3	7.8	10.9	12.9	8.2	11.5
11 years	8.6	6.4	20.1	19.8	7.3	16.9
Girls						
6-11 years	1.4	1.3	2.0	2.4	1.2	5.6
6 years	2.6	2.4	2.5	8.4	2.8	-
7 years	1.8	1.5	5.4	11.1	1.2	19.8
8 years	0.9	1.0	-	-	0.5	-
9 years	1.2	0.7	3.8	5.8	1.1	13.4
10 years	1.3	1.4	-	-	0.7	-
11 years	0.7	0.6	1.3	-	0.9	-

Table 21. Prevalence rates for past and present eye problems reported in medical history among children, by type of problem, age, and sex, with standard errors for totals: United States, 1963-65

Age and sex	Crossed eyes ever	Operation on eyes ever	Other eye trouble ever	Wears glasses or contact lenses	Trouble reading	Swollen or red lids ever	Styes, infection, other matter in eye ever
	Rate per 100 children						
Both sexes							
6-11 years	2.6	1.3	12.5	10.3	4.4	5.7	8.8
6 years	2.2	0.9	4.9	2.3	1.2	4.3	8.2
7 years	2.6	1.9	8.2	4.8	2.5	3.8	8.3
8 years	3.4	1.3	11.4	9.3	4.1	5.5	8.0
9 years	3.2	1.2	14.1	11.0	6.1	6.5	10.3
10 years	2.2	1.2	17.1	15.5	6.4	6.9	8.7
11 years	2.1	1.4	20.0	20.0	7.2	7.8	9.4
Boys							
6-11 years	2.7	1.5	11.1	9.7	4.0	5.6	7.3
6 years	2.9	1.2	4.4	2.5	1.4	3.3	6.8
7 years	3.2	1.7	6.4	4.6	3.1	3.9	9.1
8 years	2.5	1.4	10.2	8.8	3.4	6.8	6.4
9 years	2.7	1.5	12.8	9.8	5.4	6.9	6.8
10 years	2.0	1.3	15.5	14.1	4.8	5.0	7.5
11 years	2.8	1.9	18.2	19.0	6.4	8.4	7.5
Girls							
6-11 years	2.6	1.1	13.9	11.0	4.8	5.7	10.2
6 years	1.5	0.5	5.4	2.0	0.9	5.2	9.6
7 years	2.0	2.1	10.0	4.9	1.8	3.7	7.4
8 years	4.3	1.2	12.5	9.8	4.8	4.2	9.7
9 years	3.8	0.8	15.5	12.2	6.8	6.0	14.0
10 years	2.5	1.0	18.7	16.9	7.9	9.0	10.0
11 years	1.4	0.8	22.0	21.0	8.1	7.1	11.4
	Standard error						
Both sexes 6-11 years	0.26	0.16	0.48	0.68	0.33	0.32	0.65

Table 21. Prevalence rates for past and present eye problems reported in medical history among children, by type of problem, age, and sex, with standard errors for totals: United States, 1963-65—Con.

Age and sex	Eyes often water	Eyes often bloodshot	Eyes ever burn or itch	Bright lights ever bother	Sees double or blurred ever	Often rubs eyes or blinks when reading	Covers eye or holds head to one side when reading or watching TV
	Rate per 100 children						
Both sexes							
6-11 years	5.3	3.1	9.2	5.8	2.7	7.5	2.9
6 years	3.4	1.7	5.8	3.5	0.4	3.9	1.5
7 years	3.7	2.3	6.6	4.8	1.7	6.0	1.7
8 years	4.0	2.7	8.4	5.4	2.2	6.9	3.2
9 years	6.6	3.8	11.9	7.7	3.4	10.4	3.4
10 years	6.9	3.6	11.8	6.3	3.5	9.1	3.6
11 years	8.0	5.0	12.3	7.9	5.6	10.1	4.3
Boys							
6-11 years	4.8	3.9	8.8	4.9	2.2	7.8	3.0
6 years	2.8	1.3	5.5	3.2	0.3	4.0	2.2
7 years	3.9	3.2	7.5	4.6	1.6	7.9	1.7
8 years	4.0	3.6	9.3	5.4	2.3	7.5	2.8
9 years	5.7	4.3	9.1	5.8	1.8	10.7	4.1
10 years	5.2	4.6	10.7	3.8	3.2	8.5	3.6
11 years	8.0	7.0	12.0	7.2	4.6	9.1	3.9
Girls							
6-11 years	5.8	2.3	9.6	6.7	3.2	7.2	2.7
6 years	4.1	2.0	6.1	3.7	0.4	3.8	0.8
7 years	3.6	1.5	5.6	5.1	1.8	4.0	1.6
8 years	4.0	1.8	7.4	5.3	2.1	6.2	3.5
9 years	7.4	3.3	14.8	9.7	5.1	10.1	2.7
10 years	8.8	2.5	12.9	9.0	3.7	9.6	3.7
11 years	8.1	2.8	12.6	8.7	6.8	11.1	4.7
	Standard error						
Both sexes 6-11 years	0.28	0.26	0.43	0.40	0.24	0.44	0.26

Table 22. Actual and expected percent of children 6-11 years of age with a history of crossed eyes among those with and without a history of other related eye trouble, by sex, with standard errors for totals: United States, 1963-65

History of eye condition	Both sexes		Boys		Girls		Standard error		
	Actual	Expected	Actual	Expected	Actual	Expected	Both sexes	Boys	Girls
	Percent								
Operation on eyes---	50.9	2.6	56.4	2.7	42.7	2.6	5.23	7.45	9.38
No operation on eyes----------	2.0	2.6	1.8	2.7	2.1	2.6	0.21	0.33	0.25
Wears glasses-------	12.3	2.6	14.4	2.7	10.3	2.6	1.32	1.58	1.91
Does not wear glasses----------	1.5	2.6	1.4	2.7	1.6	2.6	0.20	0.29	0.27
History of blurred vision----------	5.2	2.6	6.2	2.7	4.5	2.6	1.68	2.76	1.96
No history of blurred vision-----	1.2	2.6	1.2	2.7	1.3	2.6	0.20	0.26	0.28
Sometimes covers eye----------	8.1	2.6	7.3	2.7	9.0	2.6	2.22	2.79	3.28
Does not sometimes cover eye----------	1.3	2.6	1.2	2.7	1.4	2.6	0.18	0.28	0.26

Table 23. Actual and expected prevalence rates for eye infections and functional eye abnormalities found on examination among children aged 6-11 years with and without a history of eye trouble, by sex, with corresponding standard errors: United States, 1963-65

Examination finding and history of eye trouble	Both sexes		Boys		Girls		Standard error		
	Actual	Expected	Actual	Expected	Actual	Expected	Both sexes	Boys	Girls
Styes present	Rate per 100 children								
Wears glasses	0.4	0.3	0.6	0.3	0.3	0.3	0.23	0.43	0.26
Does not wear glasses	0.3	0.3	0.2	0.3	0.3	0.3	0.07	0.09	0.11
History of styes	2.1	0.3	1.4	0.3	2.6	0.3	0.68	0.87	1.06
No history of styes	0.1	0.3	0.2	0.3	0.1	0.3	0.03	0.06	0.03
History of swollen lids	0.5	0.3	-	0.3	1.0	0.3	0.39	-	0.86
No history of swollen lids	0.3	0.3	0.3	0.3	0.3	0.3	0.06	0.10	0.10
History of other eye condition	0.7	0.3	0.5	0.3	0.9	0.3	0.29	0.36	0.46
No history of other eye condition	0.2	0.3	0.3	0.3	0.2	0.3	0.05	0.09	0.09
Conjunctivitis present									
Wears glasses	0.5	0.4	0.8	0.6	0.2	0.3	0.30	0.58	0.24
Does not wear glasses	0.4	0.4	0.5	0.6	0.3	0.3	0.08	0.13	0.08
History of styes	1.2	0.4	0.9	0.6	1.3	0.3	0.46	0.55	0.60
No history of styes	0.4	0.4	0.5	0.6	0.2	0.3	0.08	0.14	0.08
History of swollen lids	2.3	0.4	1.0	0.6	3.6	0.3	0.64	0.72	1.16
No history of swollen lids	0.3	0.4	0.5	0.6	0.1	0.3	0.07	0.13	0.05
History of watery eyes	1.5	0.4	0.6	0.6	2.2	0.3	0.64	0.60	1.26
No history of watery eyes	0.4	0.4	0.5	0.6	0.2	0.3	0.08	0.14	0.06
History of bloodshot eyes	2.2	0.4	1.6	0.6	3.2	0.3	1.03	1.12	2.18
No history of bloodshot eyes	0.4	0.4	0.5	0.6	0.2	0.3	0.07	0.12	0.07
History of burning eyes	1.2	0.4	0.3	0.6	2.1	0.3	0.34	0.32	0.60
No history of burning eyes	0.3	0.4	0.6	0.6	0.1	0.3	0.07	0.14	0.04
History of light sensitivity	1.6	0.4	1.1	0.6	2.0	0.3	0.62	0.84	0.94
No history of light sensitivity	0.4	0.4	0.5	0.6	0.2	0.3	0.07	0.13	0.06
History of other eye condition	1.0	0.4	1.2	0.6	0.8	0.3	0.31	0.62	0.24
No history of other eye condition	0.4	0.4	0.5	0.6	0.2	0.3	0.08	0.12	0.09

Table 23. Actual and expected prevalence rates for eye infections and functional eye abnormalities found on examination among children aged 6-11 years with and without a history of eye trouble, by sex, with corresponding standard errors: United States, 1963-65—Con.

Examination finding and history of eye trouble	Both sexes		Boys		Girls		Standard error		
	Actual	Expected	Actual	Expected	Actual	Expected	Both sexes	Boys	Girls
	Rate per 100 children								
Blepharitis present									
Wears glasses	0.3	0.5	0.5	0.4	0.2	0.5	0.25	0.35	0.20
Does not wear glasses	0.4	0.4	0.3	0.3	0.6	0.5	0.14	0.14	0.18
History of swollen lids	1.6	0.5	1.5	0.4	1.6	0.5	0.61	0.88	0.90
No history of swollen lids	0.4	0.4	0.3	0.3	0.5	0.5	0.13	0.12	0.17
Often rubs eyes	0.8	0.5	-	0.4	1.6	0.5	0.37	-	0.74
Does not often rub eyes	0.4	0.4	0.4	0.3	0.4	0.5	0.13	0.15	0.15
History of watery eyes	0.9	0.5	-	0.4	1.6	0.5	0.49	-	0.93
No history of watery eyes	0.4	0.4	0.4	0.3	0.5	0.5	0.12	0.14	0.13
History of other eye condition	1.0	0.5	1.2	0.4	0.8	0.5	0.40	0.61	0.37
No history of other eye condition	0.4	0.4	0.2	0.3	0.5	0.5	0.12	0.11	0.18
Strabismus present									
Wears glasses	18.7	7.0	16.8	6.4	20.4	7.6	1.99	2.37	2.18
Does not wear glasses	5.3	6.7	4.8	5.9	5.9	7.5	1.00	1.01	1.05
History of blurred vision	7.9	5.5	10.8	5.2	5.8	5.7	2.08	3.38	3.10
No history of blurred vision	5.1	5.3	4.5	4.8	5.7	5.9	0.97	0.93	1.07
Often rubs eyes	8.1	5.3	8.0	4.9	8.3	5.7	1.65	2.07	2.22
Does not often rub eyes	5.1	5.4	4.6	4.8	5.7	5.9	1.00	0.99	1.05
Sometimes covers eye	14.5	5.4	19.2	4.9	9.0	6.0	2.46	4.25	2.44
Does not sometimes cover eye	5.1	5.3	4.3	4.8	5.9	5.9	1.02	0.99	1.08
Other eye condition present									
Previous eye operation	23.7	2.7	25.8	2.7	20.5	2.6	4.47	4.75	8.39
No previous eye operation	2.5	2.7	2.4	2.7	2.6	2.6	0.30	0.31	0.39
History of other eye trouble	7.9	2.7	8.6	2.7	7.2	2.6	1.28	1.48	1.68
No history of other eye trouble	2.0	2.7	2.0	2.7	2.0	2.6	0.23	0.27	0.24
Wears glasses	10.1	2.7	9.7	2.7	10.5	2.6	2.49	2.67	2.64
Does not wear glasses	1.9	2.7	2.0	2.7	1.8	2.6	0.19	0.24	0.24

Table 24. Prevalence rates for strabismus findings on examination among children with and without a history of crossed eyes or an eye operation, by age and sex, with standard errors for totals: United States, 1963-65

Age and sex	History of crossed eyes						History of operation on eyes					
	Total with strabismus		Manifest strabismus		Latent strabismus		Total with strabismus		Manifest strabismus		Latent strabismus	
	History	No history	History	No history	History	No history	Operation	No operation	Operation	No operation	Operation	No operation
	Rate per 100 children											
Both sexes												
6-11 years	52.7	5.4	41.3	1.3	11.4	4.2	46.3	6.2	37.4	1.9	9.0	4.3
6 years	43.1	4.6	36.9	1.1	6.2	3.5	44.2	5.2	36.5	1.6	7.7	3.6
7 years	57.0	4.4	49.4	1.1	7.6	3.4	49.9	4.9	43.1	1.5	6.8	3.3
8 years	63.2	6.6	45.6	1.6	17.6	5.0	48.8	8.1	37.8	2.7	11.1	5.4
9 years	57.6	5.0	39.1	1.0	18.5	4.0	67.2	6.0	49.2	1.6	18.0	4.4
10 years	36.6	5.9	31.1	1.3	5.5	4.6	15.8	6.6	15.8	1.9	-	4.7
11 years	49.4	6.3	42.5	1.8	6.9	4.5	47.9	6.8	37.1	2.2	10.8	4.6
Boys												
6-11 years	51.9	4.7	41.9	1.3	10.0	3.4	49.8	5.4	39.2	1.8	10.7	3.5
6 years	48.7	3.8	39.3	1.5	9.4	2.3	48.5	4.6	38.0	2.1	10.6	2.4
7 years	37.0	3.2	29.0	0.5	8.0	2.7	36.6	3.8	29.5	1.0	7.2	2.8
8 years	62.8	5.7	54.0	1.9	8.8	3.7	60.8	6.4	46.0	2.7	14.8	3.8
9 years	65.8	4.7	44.6	0.8	21.3	3.9	68.4	5.4	53.6	1.1	14.8	4.3
10 years	49.4	5.5	49.4	1.4	-	4.0	27.2	6.2	27.2	2.1	-	4.1
11 years	51.0	5.6	40.8	1.7	10.2	3.9	55.1	6.0	40.2	2.1	14.9	3.9
Girls												
6-11 years	53.5	6.2	40.6	1.3	12.9	4.9	41.1	7.1	34.7	2.0	6.4	5.1
6 years	32.2	5.5	32.2	0.7	-	4.8	32.7	5.8	32.7	1.0	-	4.8
7 years	90.5	5.7	83.5	1.6	7.0	4.1	60.4	6.0	54.0	2.1	6.5	3.9
8 years	63.5	7.6	40.5	1.3	22.9	6.3	34.5	9.8	27.8	2.7	6.6	7.0
9 years	51.5	5.4	35.0	1.2	16.5	4.2	64.7	6.6	40.2	2.1	24.5	4.5
10 years	26.0	6.3	15.9	1.2	10.1	5.1	-	7.0	-	1.7	-	5.3
11 years	46.0	7.0	46.0	1.8	-	5.2	29.2	7.6	29.2	2.4	-	5.2
	Standard error											
Both sexes 6-11 years	4.36	1.03	3.65	0.23	3.29	0.85	6.01	1.01	5.63	0.21	3.44	0.87

APPENDIX I

STATISTICAL NOTES

The Survey Design

The sample design for the second cycle of the Health Examination Survey, similar to the one used for the first cycle, was that of a multistage, stratified probability sample of loose clusters of persons in land-based segments. Successive elements dealt with in the process of sampling are primary sampling unit (PSU), census enumeration district (ED), segment, household, eligible child (EC), and the sample child (SC).

At the first stage, the nearly 2,000 PSU's into which the United States (including Hawaii and Alaska) had been divided and then grouped into 357 strata for use in the Current Population Survey and Health Interview Survey were further grouped into 40 superstrata for use in Cycle II of the Health Examination Survey. The average size of each Cycle II stratum was 4.5 million persons, and all strata fell between the limits of 3.5 and 5.5 million. Grouping into 40 strata was done in a way that maximized homogeneity of the PSU's included in each stratum, particularly with regard to the degree of urbanization, geographic proximity, and degree of industrialization. The 40 strata were classified into 4 broad geographic regions (each with 10 strata) of approximately equal population and cross-classified into 4 broad population density groups (each having 10 strata). Each of the 16 cells contained either two or three strata. A single stratum might include only one PSU, only part of a PSU (e.g., New York City, which represented two strata), or several score PSU's.

To take account of the possible effect that the rate of population change between the 1950 and 1960 Census might have had on health, the 10 strata within each region were further classified into four classes ranging from those with no increase to those with the greatest relative increase. Each such class contained either two or three strata.

One PSU was then selected from each of the 40 strata. A controlled selection technique was used in which the probability of selection of a particular PSU was proportional to its 1960 population. In the controlled selection an attempt was also made to maximize the spread of the PSU's among the States. While not every one of the 64 cells in the 4x4x4 grid contributes a PSU to the sample of 40 PSU's, the controlled selection technique ensured the sample's matching the marginal distributions in all three dimensions and being closely representative of all cross-classifications.

Generally, within a particular PSU, 20 ED's were selected with the probability of selection of a particular ED proportional to its population in the age group 5-9 years in the 1960 Census, which by 1963 roughly approximated the population in the target age group for Cycle II. A similar method was used for selecting one segment (cluster of households) in each ED. Each of the resultant 20 segments was either a bounded area or a cluster of households (or addresses). All of the children in the age range properly resident at the address visited were EC's. Operational considerations made it necessary to reduce the number of prospective examinees at any one location to a maximum of

200. The EC's to be excluded for this reason from the SC group were determined by systematic subsampling.

The total sample included 7,417 children from 25 different States in the age group 6-11 years, with approximately 1,000 in each of the single years of age.

Reliability

Measurement processes employed in the survey were highly standardized and closely controlled. Of course, this does not mean that the correspondence between the real world and the survey results is exact. Data from the survey are imperfect for three major reasons: (1) results are subject to sampling error, (2) the actual conduct of a survey never agrees perfectly with the design, and (3) the measurement processes themselves are inexact even though standardized and controlled.

The first report on Cycle II[4] describes in detail the faithfulness with which the sample design was carried out. It notes that out of the 7,417 sample children the 7,119 who were examined—a response rate of 96 percent—gave evidence that they were a highly representative sample of children of this age in the noninstitutional population of the United States. The response levels for the various demographic subgroups—including those for age, sex, race, region, population density, parents' educational level, and family income—show no marked differentials. Hence it appears unlikely that nonresponse could bias the findings much in these respects.

Measures used to control the quality of data from this survey in general have been cited previously.[4,5]

Data recorded for each sample child are inflated in the estimation process to characterize the larger universe of which the sample child is representative. The weights used in this inflation process are a product of the reciprocal of the probability of selecting the child, an adjustment for nonresponse cases, and a poststratified ratio adjustment which increases precision by bringing survey results into closer alignment with known U.S. population figures by color and sex within single years of age 6-11.

In the second cycle of the Health Examination Survey, the sample was the result of three stages of selection—the single PSU from each stratum, the 20 segments from each sample PSU, and the sample children from the eligible children. The probability of selecting an individual child is the product of the probabilities of selection at each stage.

Since the strata are roughly equal in population size and a nearly equal number of sample children were examined in each of the sample PSU's the sample design is essentially self-weighting with respect to the target population; that is, each child 6-11 years had about the same probability of being drawn into the sample.

The adjustment upward for nonresponse is intended to minimize the impact of this factor on final estimates by imputing to nonrespondents the characteristics of "similar" respondents. Here "similar" respondents were judged to be examined children in a sample PSU having the same age (in years) and sex as children not examined in that sample PSU.

The poststratified ratio adjustment used in the second cycle achieved most of the gains in precision which would have been attained if the sample had been drawn from a population stratified by age, color, and sex and made the final sample estimates of population agree exactly with independent controls prepared by the Bureau of the Census for the noninstitutional population of the United States as of August 1, 1964 (approximate mid-survey point), by color and sex for each single year of age 6-11. The weight of every responding sample child in each of the 24 age, color, and sex classes is adjusted upward or downward so that the weighted total within the class equals the independent population control.

In addition to children not examined at all, there was one child not given the eye examination and several whose phoria tests could not be completed because of their limited visual acuity. No attempt was made to estimate these missing data. It was assumed that the distribution of findings among them would be similar to that among those whose examination had been completed.

Sampling and Measurement Error

In the present report, reference has been made to efforts to minimize bias and variability of measurement techniques.

The probability design of the survey makes possible the calculation of sampling errors. The sampling error is used here to determine how imprecise the survey test results may be because they come from a sample rather than from the measurement of all elements in the universe.

The estimation of sampling errors for a study of the type of the Health Examination Survey is difficult for at least three reasons: (1) measurement error and "pure" sampling error are confounded in the data—it is not easy to find a procedure which will either completely include both or treat one or the other separately, (2) the survey design and estimation procedure are complex and accordingly require computationally involved techniques for the calculation of variances, and (3) from the survey are coming thousands of statistics, many for subclasses of the population for which there are a small number of cases. Estimates of sampling error are obtained from the sample data and are themselves subject to sampling error which may be large when the number of cases in a cell is small or even occasionally when the number of cases is substantial.

Estimates of approximate sampling variability for selected statistics used in this report are shown in several of the detailed tables in the form of standard errors of estimate. These estimates have been prepared by a replication technique which yields overall variability estimates through observation of variability among random subsamples of the total sample as described previously.[10] This method reflects both "pure" sampling variance and a part of the measurement variance. A similar pseudoreplication technique was used to estimate the standard errors of the correlation coefficients shown in the Findings sections.[11]

In accordance with usual practice, the interval estimate for any statistic may be considered the range within one standard error of the tabulated statistic with 68-percent confidence, or the range within two standard errors of the tabulated statistic with 95-percent confidence. The latter is used as the level of significance in this report.

An overestimate of the standard error of a difference $d = x\text{-}y$ of two statistics x and y is given by the formula $S_d = (S_x^2 + S_y^2)^{\frac{1}{2}}$ where S_x and S_y are the sampling errors, respectively, of x and y.

Small Categories

In some tables, magnitudes are shown for cells for which the sample size is so small that the sampling error may be several times as great as the statistic itself. Obviously in such instances the statistic has no meaning in itself except to indicate that the true quantity is small. Such numbers, if shown, have been included in the belief that they may help to convey an impression of the overall story of the table.

APPENDIX II

RECORDING AND HISTORY FORMS

Eye Examination

EYES

(11) ☐ 1 No findings ☐ 2 Findings

FINDINGS

(12) ☐ 1 Stye (13) ☐ 1 Conjunctivitis (14) ☐ 1 Blepharitis

(15) ☐ 1 Strabismus (indicate type—location and tests positive)

(16) Manifest—R: ☐ 1 IN ☐ 2 OUT ☐ 3 UP ☐ 4 DOWN

(17) L: ☐ 1 IN ☐ 2 OUT ☐ 3 UP ☐ 4 DOWN

(18) Latent— R: ☐ 1 IN ☐ 2 OUT ☐ 3 UP ☐ 4 DOWN

(19) L: ☐ 1 IN ☐ 2 OUT ☐ 3 UP ☐ 4 DOWN

FINDINGS ON: (20) ☐ 1 Observation (21) ☐ 1 Moving light

(22) ☐ 1 Hirschberg test (23) ☐ 1 Screen test

(24) ☐ 1 Other (Specify) .....

Vision Tests

EXAMINER	NO REPORT

Wears glasses for test: ☐ Yes ☐ No

COLOR VISION TEST NO. 1—Ishihara binocular test (with glasses if worn)

PLATE	READ AS		PLATE	READ AS	
1	☐ 12	☐ Other	14	☐ Other	☐ 5
2	☐ 8	☐ 3 ☐ Other	16	☐ 42	☐ 2 ☐ 42
5	☐ 5	☐ 2 ☐ Other			☐ 4 ☐ 42
8	☐ 2	☐ Other			☐ Other
11	☐ 5	☐ Other			
			SCORE:*		

VISION—DISTANCE

VISION TESTS (without glasses)

Check tests given first. ☐ Far ☐ Near (Odd numbers far first; even numbers near first)

DIAL

1. BINOCULAR LATERAL PHORIA—DISTANCE (Check number nearest arrow) (Diopter units)

☐ Left of 1 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 / ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 / ☐ 17 ☐ 18 ☐ 19 ☐ 20 ☐ 21

☐ Right of 21 ☐ Arrow or number not visible. (Normal = 11) Code .....

2. MONOCULAR DISTANCE—SMALL*

Line	Right eye	Score (Check)	Left eye	Score
5	VHDNS OZKRC	 50	CDZNO KSRVH	 50
6	DVZNC SRHKO	 40	CNRKH ZVSDO	 40
7	KNZCO SRDHV	 30	DVHCK OZNSR	 30
8	KNDRS ZVCOH	 25	CDKRO SZVNH	 25
9	VZCHD KNRSO	 20	CVHSZ ORKDN	 20
10	KZSVN HCRDO	 17	DNVHS OKRCZ	 17
11	RCSNV KDHOZ	 15	ZHODC SVNKR	 15
12	ROKHZ NSCVD	 12	KHOZD CSNVR	 12

3. MONOCULAR DISTANCE—LARGE*
(*Omit if score on Dial 2*)

Line	Right eye	Score	Left eye	Score
1	SDK	 400	VNC	 400
2 / 2	RCSZO / KNHDV	 200	OZNKS / DRHCV	 200
3	HNZOS KRCVD	 100	RZOHC KSNDV	 100
4	ZHODC SVNKR	 70	RKNCZ HSDVO	 70

CODE ..... CODE .....

3A. BINOCULAR DISTANCE—SMALL*

Line	Score
5	OSDNH VKZCR 50
6	RHZCD OSVKN 40
7	SVNHO KCRDZ 30
8	RHSCK OZDVN 25
9	OZRVN HSCKD 20
10	DRHVN ZSKCO 17
11	OSKCV RZHDN 15
12	SKHDN OCVRZ 12

4A. BINOCULAR DISTANCE—LARGE*
(*Omit if score on Dial 3A*)

Line	Score
1	KDS 400
2 / 2	ZSKCO / VRHDN 200
3	ZNSKH VDRCO 100
4	OZCRH NSKDV 70

CODE ..... (Regular test)

DIOPTER TEST** (Check):

☐ 1. Scored at level of regular test.

☐ 2. Failed at level of regular test.

☐ 9. Test not given.

5. BINOCULAR VERTICAL PHORIA—DISTANCE (Check step number dotted line intersects if extended) (Normal = 5)

☐ Below 1 / ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 / ☐ Above 9 (⅓ diopter units) CODE .....

*Diagonal line through each letter missed; horizontal line through sections of line not attempted and through top full line not attempted.
**Retest with diopter (3+) lenses *at level reached* only those who score 20, 17, 15, or 12, on regular test. Binocular distance, test without regular glasses only.

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SAMPLE NO.

VISION—NEAR

6. BINOCULAR LATERAL PHORIA—NEAR (Check number nearest arrow) (Diopter units)

☐ Left of 1 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 / ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14
☐ 15 ☐ 16 ☐ 17 ☐ 18 / ☐ 19 ☐ 20 ☐ 21 ☐ 22 ☐ 23 ☐ 24 ☐ 25 ☐ 26 ☐ 27 ☐ 28 ☐ 29
☐ 30 ☐ 31 ☐ 32 ☐ 33 ☐ Right of 33 (Normal = 13) CODE .....

7. MONOCULAR NEAR—SMALL*

Line	Right eye	Score (check)	Left eye	Score
5	CVRZS DKHNO	 50	ZKCRV OHSDN	 50
6	VZKCO HRSDN	 40	SDKVO ZRHNC	 40
7	HSZKN OVCDR	 30	DHZRV SOKNC	 30
8	OVRHS CNDZK	 25	DKOSN RVZCH	 25
9	ZHCOR VDNSK	 20	RKZVD OSNCH	 20
10	RHCVN SDKZO	 17	OKSRN DHVCZ	 17
11	CNZSR OHKDV	 15	VRCHN OZKSD	 15
12	ODCNH VRSKZ	 12	ROHKS VDNCZ	 12

8. MONOCULAR NEAR—LARGE*
(Omit if score on Dial 7)

Line	Right eye	Score	Left eye	Score
1	NCV	 400	DSK	 400
2 / 2	HNRCD / VOSZK	 200	CRSZO / NDVHK	 200
3	NDOCV RSZKH	 100	OKZHS NCVRD	 100
4	VRCNZ OSDHK	 70	RCOVN DHKSZ	 70

CODE ..... CODE .....

9. BINOCULAR NEAR—SMALL*

Line		Score
5	OCVKR ZNSDH	 50
6	ZHOCV NDRKS	 40
7	SDOVK HRNZC	 30
8	DNHKO ZSRVC	 25
9	DSVKH ZNOCR	 20
10	NZHKO RCVDS	 17
11	SNCZO RKVHD	 15
12	DHNVO SCZKR	 12

NS5. BINOCULAR NEAR—LARGE*
(Omit if score on Dial 9)

Line		Score
1	NVC	 400
2 / 2	CZHSN / DKORV	 200
3	KSDVO NHZCR	 100
4	VZOCS HRNKD	 70

CODE .....

BINOCULARITY TEST—WORTH 4-DOT TEST (Check number of dots seen)

NEAR (14 inches) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ Other (Code 8)

DISTANCE (10 feet) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ Other (Code 8)

**Diagonal line through each letter missed; horizontal line through sections of line not attempted and through top full line not attempted.*

VISION

LANDOLT RING VISUAL ACUITY TESTS

DIOPTER TEST ** (Check)

☐ 1 Scored at regular test level
☐ 2 Failed at regular test level
☐ 9 Test not given .....

DISTANCE TESTS* (at 10 feet)

LINE (Code)	RIGHT EYE	SCORE (Check)	LEFT EYE	SCORE	BINOCULAR	SCORE
1	UDLUR	 200	UDLUR	 200	UDLUR	 200
2	RURDL	 100	RURDL	 100	RURDL	 100
3	DLDRL	..... 71.4	DLDRL	..... 71.4	DLDRL	..... 71.4
4	LRDLU	 50	LRDLU	 50	LRDLU	 50
5	URUDL	..... 39.3	URUDL	..... 39.3	URUDL	..... 39.3
6	DUDRL	..... 28.6	DUDRL	..... 28.6	DUDRL	..... 28.6
7	UDRLD	 25	UDRLD	 25	UDRLD	 25
8	RULDL	..... 21.4	RULDL	..... 21.4	RULDL	..... 21.4
9	LUDLR	..... 17.9	LUDLR	..... 17.9	LUDLR	..... 17.9
10	ULDRU	..... 14.3	ULDRU	..... 14.3	ULDRU	..... 14.3
11	DURLU	..... 10.7	DURLU	..... 10.7	DURLU	..... 10.7
	CODE:		CODE:		CODE:	

NEAR TESTS* (at 14 inches)

LINE (Code)	RIGHT EYE	SCORE (Check)	LEFT EYE	SCORE	BINOCULAR	SCORE
1	RUDLD	 200	RUDLD	 200	RUDLD	 200
2	DLRDR	 160	DLRDR	 160	DLRDR	 160
3	RDURU	 125	RDURU	 125	RDURU	 125
4	UDRUR	 100	UDRUR	 100	UDRUR	 100
5	RLDLU	 80	RLDLU	 80	RLDLU	 80
6	URLUD	 60	URLUD	 60	URLUD	 60
7	LDURD	 50	LDURD	 50	LDURD	 50
8	DRDUL	 40	DRDUL	 40	DRDUL	 40
9	ULUDR	 30	ULUDR	 30	ULUDR	 30
10	DRURL	 25	DRURL	 25	DRURL	 25
11	LDRUD	 20	LDRUD	 20	LDRUD	 20
	CODE:		CODE:		CODE:	

*Diagonal line through each letter missed; horizontal line through sections of line not attempted and through top full line not attempted.
**Retest with diopter (3+) lenses at level reached only those who score 20, 17, 15, or 12 or equivalent (21.4, 17.9, etc.) on regular test. Binocular distance test without regular glasses only.

CHILD'S MEDICAL HISTORY - Parent

41. HERE ARE SOME QUESTIONS ABOUT YOUR CHILD'S EYES.

A. Has he(she) ever had crossed eyes?

1 ☐ Yes 2 ☐ No 3 ☐ Don't know

B. Has he(she) ever had an operation on his(her) eyes?

1 ☐ Yes 2 ☐ No 3 ☐ Don't know

IF YES, what was it for? _____

_____

C. Has he(she) ever had other trouble with his(her) eyes?

1 ☐ Yes 2 ☐ No 3 ☐ Don't know

IF YES, what kind of trouble? _____

_____

D. Does he(she) wear either glasses or contact lenses?

1 ☐ Yes 2 ☐ No 3 ☐ Don't know

42. IF HE(SHE) DOES NOT WEAR GLASSES:

A. Does he(she) ever have trouble reading or doing fine work?

1 ☐ Yes 2 ☐ No 3 ☐ Don't know

B. Do his(her) eyes or eyelids ever swell up or get red?

1 ☐ Yes 2 ☐ No 3 ☐ Don't know

C. Does he(she) ever have styes, infections, or 'matter' in his(her) eyes?

1 ☐ Yes 2 ☐ No 3 ☐ Don't know

D. Do his(her) eyes often water?

1 ☐ Yes 2 ☐ No 3 ☐ Don't know

E. Are his(her) eyes often bloodshot?

1 ☐ Yes 2 ☐ No 3 ☐ Don't know

F. Does he(she) ever say that his(her) eyes burn or itch?

1 ☐ Yes 2 ☐ No 3 ☐ Don't know

G. Does bright light bother his(her) eyes?

1 ☐ Yes 2 ☐ No 3 ☐ Don't know

H. Does he(she) ever see double or see things blurred?

1 ☐ Yes 2 ☐ No 3 ☐ Don't know

I. Have you seen him(her) often rub his(her) eyes or blink when he(she) is reading?

1 ☐ Yes 2 ☐ No 3 ☐ Don't know

J. Does he(she) sometimes close or cover one eye or hold his head on one side when he(she) reads or watches T.V.?

1 ☐ Yes 2 ☐ No 3 ☐ Don't know

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